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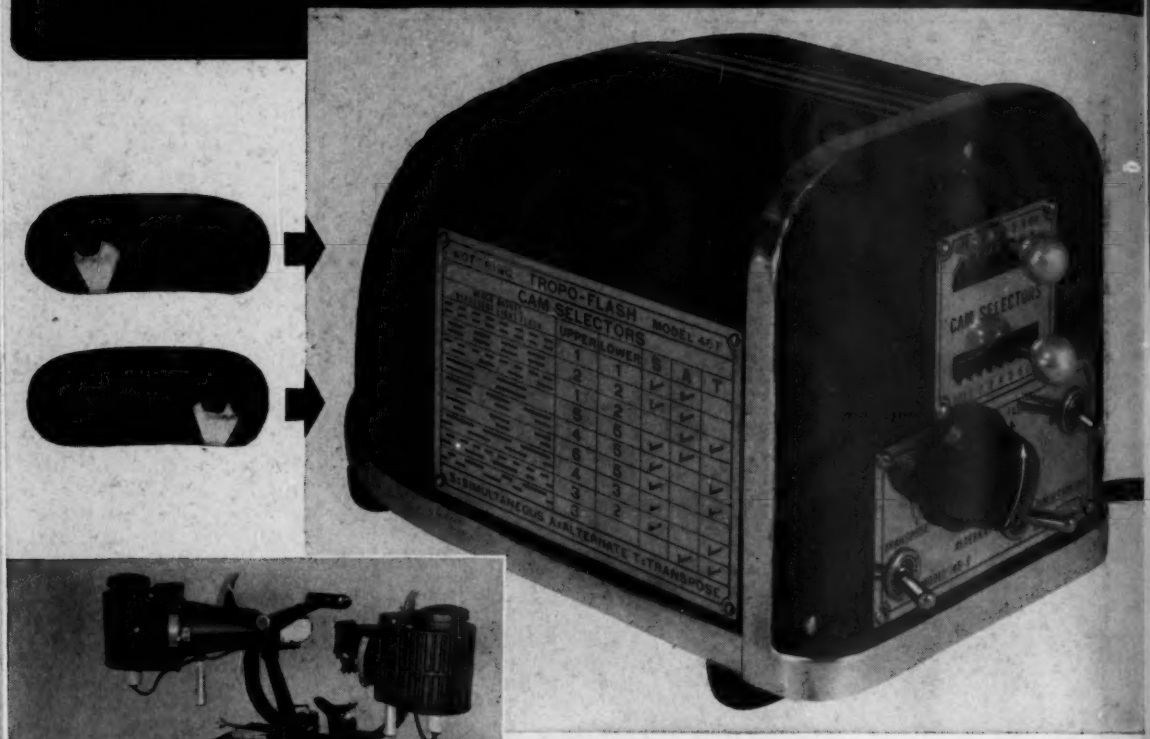

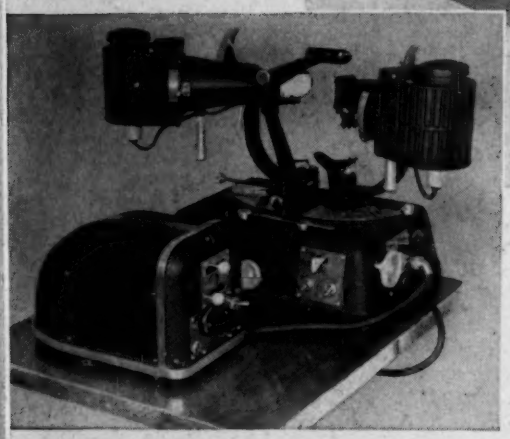

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 30 APRIL, 1947 NUMBER 4

TYPES OF CONGENITAL CATARACT*

THE SANFORD R. GIFFORD MEMORIAL LECTURE

FREDERICK C. CORDES, M.D.
San Francisco

I appreciate very highly the great honor you have conferred upon me by asking me to present the Sanford R. Gifford Memorial Lecture. May this presentation be worthy of that honor.

To have known Dr. Sanford R. Gifford as a scientist, an ophthalmologist, a teacher, and a clinician was an inspiration. His modest, unassuming bearing, combined with his consideration of others, endeared him to all who came in contact with him. To have known "Sandy" Gifford as a colleague, as a companion of the trail, and a campmate at the Bohemian Grove was a rare privilege. Indeed, these memories are among my most cherished.

I have taken as my subject a discussion of the various types of congenital cataracts, a condition that I have been interested in for a number of years. It also seems a particularly appropriate topic because of Dr. Gifford's interest in the subject; he having written three papers on congenital cataracts, two in the American and one in the German Literature. In addition, he and Dr. Latta, in 1923, discussed what is now referred to as retrolental fibroplasia or persistence and hyperplasia of the primary vitreous.

A thorough knowledge of congenital cataracts is essential for the proper interpretation of slitlamp findings and for an intelligent discussion of the condition with the patient or the patient's parents. Inasmuch as most congenital cataracts are stationary and cause no interference with vision, this knowledge makes it seem wise often not to tell the patient of his condition and thus avoid a great deal of unnecessary worry. This knowledge also permits an intelligent discussion of the prognosis and treatment in cases of the more extensive type of congenital cataract when parents bring their children to the ophthalmologist at an early age. In addition, it is possible in certain instances to assure the parents that in all probability future siblings will not have the same anomaly.

Certain forms of congenital cataracts show an hereditary tendency. These seem to be primarily the dominant type. The type may not always be consistent so that lamellar, polar, spindle, and central cataracts all may occur in the same family. In some instances, however, the type may be the same in all members of the family involved. Haro,[1] for example, observed a family of 59 persons, covering four generations, in which 16 members had ring or disc-shaped cataracts. Atypical forms have been observed through several generations.

It is noteworthy that in 50 percent of the cases of congenital cataract other ocu-

* From the Division of Ophthalmology, University of California Medical School. Read at the Chicago Ophthalmological Society meeting, January 20, 1947. Art work made possible by funds from the Mrs. E. S. Heller Donations.

lar disturbances are present. These include strabismus, amblyopia, nystagmus, aniridia, choroidal and retinal changes, microphthalmus, and other anomalies.

With the introduction of the slitlamp and corneal microscope, our knowledge of congenital cataracts has been enriched by the systematic study of the lens as seen with the widely dilated pupil. Thus, we know that there are many fine congenital cataracts that were unknown to older observers, and which are only visible to us now because of the slitlamp. A clear lens, one in the sense of a good photographic or microscope lens, is probably nonexistent in the human eye, as practically all lenses, even those of young children, show some punctate or dustlike opacities. How many of these opacities were present before birth and how many may have developed in the first few years of life is naturally a difficult thing to judge.

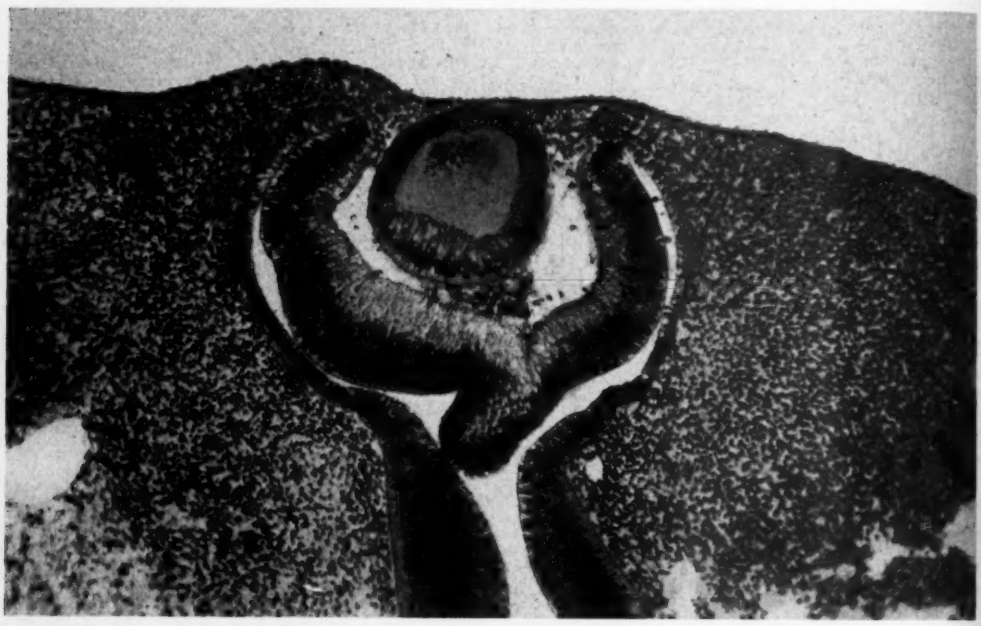

Fig. 1 (Cordes). Section through the eye of a 7- to 8-mm. human embryo (four weeks). The fetal fissure is still open, and the lens vesicle is still connected to the surface. Cells of the posterior wall of the lens vesicle are beginning to elongate. The so-called "epitrichial" cells are enclosed in the lens vesicle.

As pointed out by Ida Mann,[2] a certain number of congenital abnormalities can be explained as abnormal persistences of a normally transient condition. But it must also be borne in mind that a greater part of so-called developmental anomalies do not represent any normal stage, but are pure aberrations of growth. The most that can be said in regard to the production of these developmental anomalies is that it is possible to deduce from their location and to place accurately the time at which the fibers involved were formed. Whether the opacities occurred at this initial time or whether they occurred as the result of a subsequent degeneration, it is impossible to say.

Embryology of the Lens

Some knowledge of the embryology of the lens is necessary for a proper understanding of the biomicroscopy of the

lens. The lens arises from ectoderm. In a 4.5-mm. human embryo Ida Mann[3] was able to identify the lens plate. According to Ida Mann[4] this formation is followed by a symmetrical indentation of the lens plate to form the lens pit. This in turn invaginates to form the lens vesicle which is complete by the 7- to 8-mm. (fig. 1) stage; however, the vesicle is still connected to the surface. The primary lens fibers now begin to form from the cells of the posterior wall. It must be remembered that the whole adult lens is formed from the cells of the posterior wall and the equatorial region, the anterior wall of the lens vesicle taking no part in the formation of lens fibers. During this stage, the tunica vasculosa lentis also begins to form. By the time the 10-mm. stage (5 weeks) has been reached, the lens vesicle is separated from the surface but the fetal fissure is still open (fig. 2). The primary lens fibers now fill half of the lens vesicle. At the 18-mm. stage (7 weeks) the fetal fissure is closed and the cavity of the lens vesicle is almost filled. The hyaloid artery and the tunica vasculosa are present at this stage. By the 26-mm. stage (8 weeks) the primary fibers are complete (fig. 3). These primary fibers remain at the exact center of the lens throughout life, and form the embryonal nucleus. Where these fibers come in contact with the fibers from the opposite side they form the lens sutures, the anterior erect Y and the posterior inverted Y. During this time the lid buds also make their appearance. In the 65-mm. stage (11 weeks), we find that the embryonic nucleus is now surrounded by the secondary lens fibers. Bowman's and Descemet's membranes are also present in the cornea, and the lids have formed.

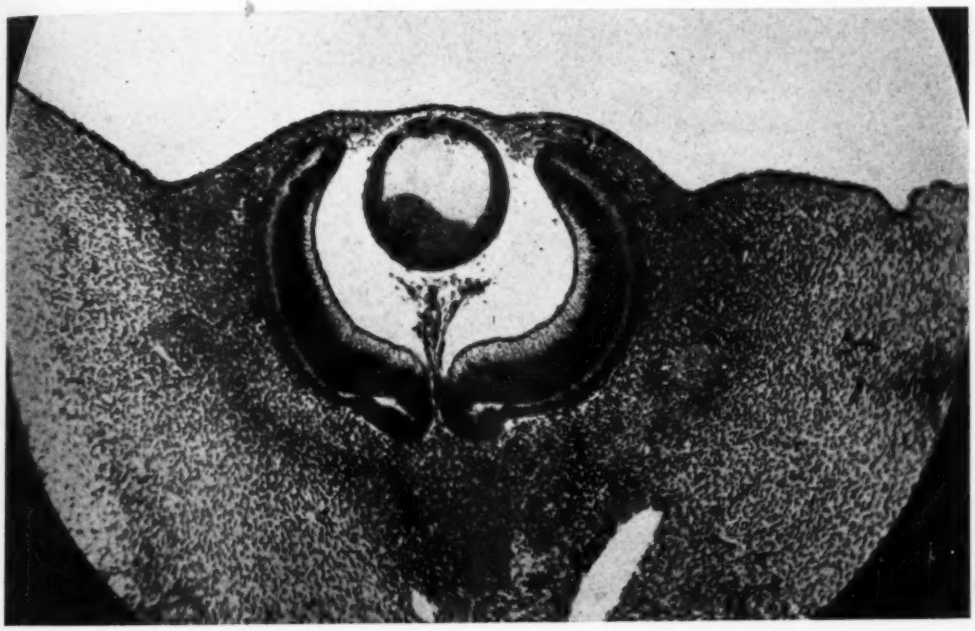

Fig. 2 (Cordes). Section through the eye of a 10-mm. (five weeks) human embryo. The lens vesicle has separated from the surface. Further elongation of the cells of the posterior wall is evident, and there is a decrease in the enclosed epitrichial cells. The hyaloid artery is present and the tunica vasculosa lentis is beginning to appear.

The secondary fibers continue to form throughout life by division of cells of the equatorial region. The complicated pattern of sutures causes these fibers to become closely merged. These patterns differ and their surfaces possess slightly different indices of refraction, so that, by using the slitlamp, the various stages of development can be determined (fig. 4).

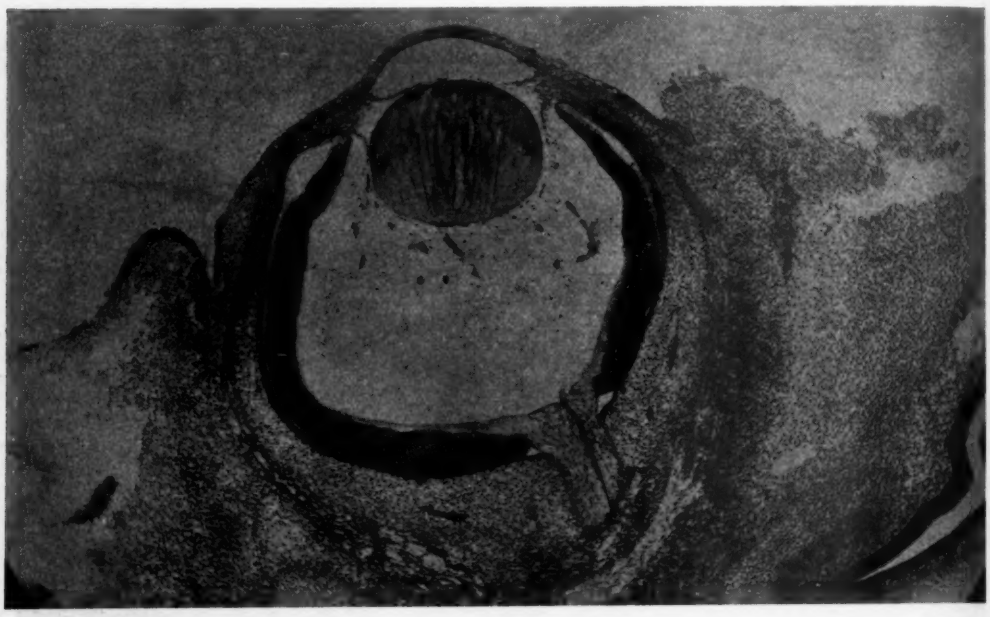

Fig. 3 (Cordes). Section through the eye of a 30-mm. embryo. The formation of the primary lens fibers is complete, and the embryonic nucleus is formed. In the equatorial region, the secondary fibers are forming. The anterior chamber is present, and the tunica vasculosa is complete. The lid buds are present.

The tunica vasculosa lentis is a capillary network that surrounds the lens during its development. It is derived from the hyaloid artery and appears during the fifth week. As the hyaloid artery develops, it branches throughout the primary vitreous to form the posterior part of the tunica vasculosa lentis. The central part of the network is formed from vessels that come in from the upper edge of the optic cup and from the equatorial portion. The anterior part is derived from the vascular system of the iris. Practically the whole of this elaborate vascular system surrounding the lens atrophies and disappears between the seventh and ninth months, but remnants of it can often be seen even in old age in a large number of people. The anterior part, or pupillary membrane, persists relatively late. Ida Mann[5] described this as seen both in section and as it appears in fetal eyes of five to nine months as observed with the slitlamp. The failure of this atrophy may have a bearing on retrolental fibroplasia.

Any arrest of development causes changes in the lens. Those changes occurring before the fourth week are more profound, and the result is gross abnormalities of the eye itself. Those changes that occur between the fourth and sixth weeks result in gross abnormalities of the various structures of the eye. Mann[6] states that delay of closure and separation of the lens vesicle from the surface ectoderm

permits the lens fibers to grow forward and protrude through the opening in the capsule with a resultant anterior-capsular opacity. The failure of the development of lens fibers from the cells of the back wall of the lens vesicle leads to an absence of the central portion of the lens and results in the formation of a congenital disc-shaped cataract.

portion of the lens that is formed before the third month.

2. *Fetal nucleus* is the term applied to the zone between the embryonal nucleus and the next reflecting surface. This nucleus begins to be formed in the third month and is formed during intrauterine life.

3. *The adult nucleus* is enclosed by the

Fig. 4 (Cordes). Sagittal section through the eye of a 65-mm. (11 weeks) embryo. The embryonic nucleus is surrounded by the developing secondary fibers. The cornea with Bowman's and the beginning of Descemet's membrane is present. The formation of the lids is complete.

The diagnosis of congenital cataracts is to a great extent dependent upon biomicroscopy of the lens. With the fine beam of the slitlamp and the corneal microscope, the suture lines and certain surfaces representing stages in the development of the lens are visible throughout life. Four zones can easily be differentiated.

1. *Embryonal nucleus.* This is the central layer between the Y sutures and is the next reflecting surfaces and will later become the lens of adult life. It is formed during adolescence and early adult life.

4. *A cortex* covering these various strata and consisting of fibers laid down in later life forms the next layer which is its largest in old age.

These layers are covered by the lens capsule and anterior epithelium. Just nasal to the posterior pole of the lens the hyaloid artery attaches itself for a time to the

lens capsule and sends branches over its surface (tunica vasculosa lentis). At 8½ months it disappears, but persists as a corkscrewlike thread (hanging into the vitreous) which may be seen with the slitlamp in adult life. At times its attachment

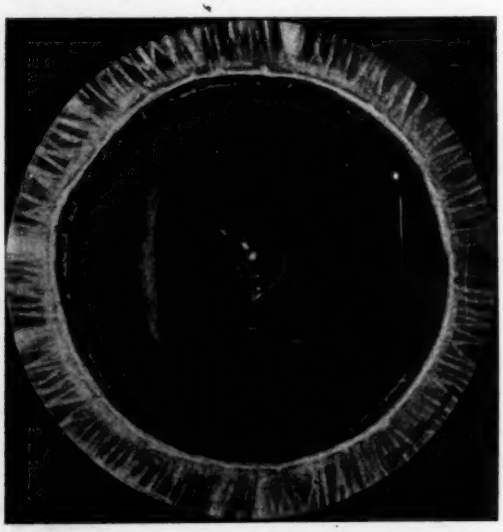

Fig. 5 (Cordes). Anterior axial embryonal cataract.

may be seen with the ophthalmoscope as a fairly large dot, the posterior lens dot, and is sometimes referred to as a posterior-lens cataract. This form does not interfere with vision as it is always located slightly nasal to the posterior pole.

During life, the lens continues to increase in size by the growth of new lens fibers from the cells just beneath the capsule, which are the only ones to retain their nuclei. These fibers are in turn displaced centrally by the development of other new fibers. Thus the subcapsular opacity left by an injury to the lens received in childhood is found in adult life to be located in the deeper layers of the lens and the period at which such an injury occurred can be determined rather accurately with the slitlamp.

Congenital lens opacities

Anterior axial embryonal cataract

This is the most frequent form of congenital cataract. According to Vogt[7] it occurs in approximately 25 percent of all individuals. The cataract consists of multiple fine opacities that are irregular in form and lie in close proximity to the anterior embryonal suture and usually at its exact level. In direct light these opacities appear as white, chalklike bodies which on occasion may have a crystalline appearance. The opacities are surrounded by a faint halo, and are usually multiple although they can occur as single opacities (fig. 5). They cause no interference with vision and, like all congenital cataracts, are stationary. The formation of this type of cataract probably occurs in the fourth embryonal month. Vogt[7] says: "It is conceivable that the opacity has its origin in an early stage in which the cavity of the lens vesicle was becoming obliterated and the included cells were not absorbed." Ida Mann[8] does not feel this is likely since any cell remnants in the cavity of the lens

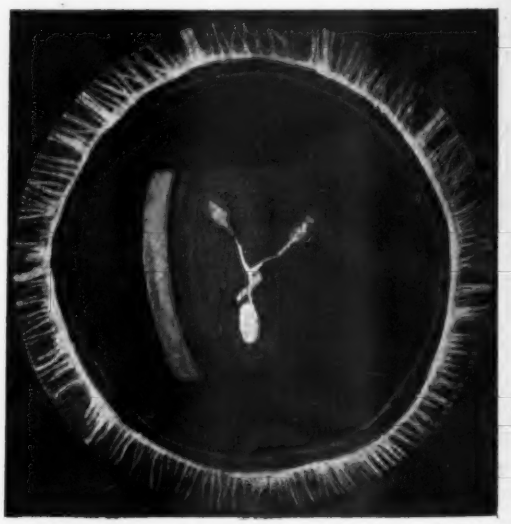

Fig. 6 (Cordes). Stellate (sutural) cataract involving the anterior Y.

vesicle would be present either immediately under the anterior capsule or, conceivably, somewhere in the line of the anterior embryonic suture, but not behind or to either side of this. It is noteworthy that the anterior embryonal cataract is the only form of cataract that does not occur symmetrically in the anterior and posterior half of the lens.

Stellate (sutural or triradiate) cataract

Vogt[9] was the first to demonstrate that these congenital sutural cataracts occur in either the anterior or posterior suture, but more frequently the posterior (fig. 6). The sutures appear as white, thick lines extending as far as the branching and are accompanied by a varying-sized zone of opacification that is blue-green in color. The reverse color arrangement can also occur. These colors, which are also present in cataracta cerulea, are caused by the varying thickness of the opacities, the thinner having the greater tendency to the blue tint. Very thin opacities which are not visible in reflected light, appear blue-green in direct light in contrast to the yellowish lens. If these opacities are denser, they appear white. On rare occasions these clouded sutures appear in layers. This unusual condition is explained either by recurrent damage during the developmental stage or through the interposition of newly formed lens fibers. Duke-Elder[10] believes that the stellate cataract develops subcapsularly during intrauterine life, probably about the time of birth. These cataracts are stationary, but the larger ones may interfere with vision.

Punctate cataract (cataracta punctata)

Scattered small gray or light blue opacities are found in the extreme periphery of most young lenses. When these opacities are scattered throughout the lens without involving the embryonal nucleus, they are called punctate cataract. This cataract must be differentiated from cataracta coronaria which may begin with light blue opacities in the equator of the

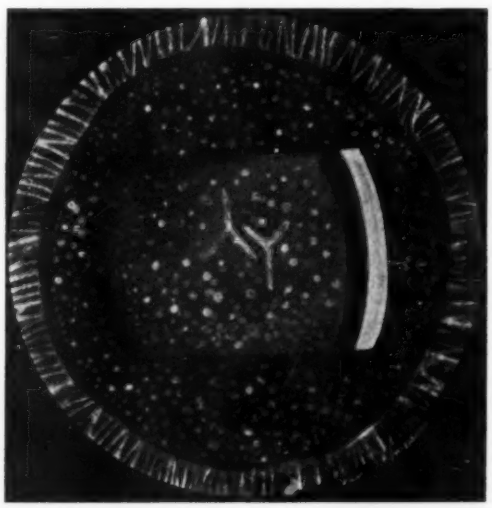

Fig. 7 (Cordes). Punctate cataract in which the opacities are scattered throughout the lens without involving the embryonal nucleus.

lens. According to Duke-Elder[11] an almost identical type occurs in Mongolian idiocy, in which condition it usually develops about puberty. True congenital punctate cataracts are very rare and may be associated with stellate cataract. Collins[12] felt that the opacities represent late-formed fibers which have undergone degeneration and have broken down into granular debris, and have then subsequently been surrounded by healthy fibers (fig. 7).

Congenital opacities at the anterior pole of the lens

Bellows[13] classifies the congenital opacities of the anterior pole of the lens into three groups: (1) Anterior or pyramidal (central punctiform) cataract. (2) Capsular flakes. (3) Circular cataract.

1. Anterior polar or pyramidal (central punctiform) cataract. This cataract (fig. 8) consists of a sharply circumscribed opacity of the anterior lens capsule. The opacity varies greatly in size from pinhead to an opacity that may fill the pupillary area. It is often laminated and is a conical projection in many instances, being sometimes directed toward the nucleus but usually projecting above the lens. According to Jess[14] there may at times be a fine thread connecting the opacity to the cornea. This type of cataract is easily recognized by parents who then bring their children to the ophthalmologist. Not infrequently fine lines radiate from the opacity, and the cortex beneath may also be involved. The visual loss is dependent upon the size of the opacity; if this opacity is rather large, vision may be much better in dim light. Like most congenital cataracts the condition remains stationary in most instances, although Jess[14] states that cases have been reported in which the opacity progressed to complete opacification. A similar form may follow small perforations of the cornea.

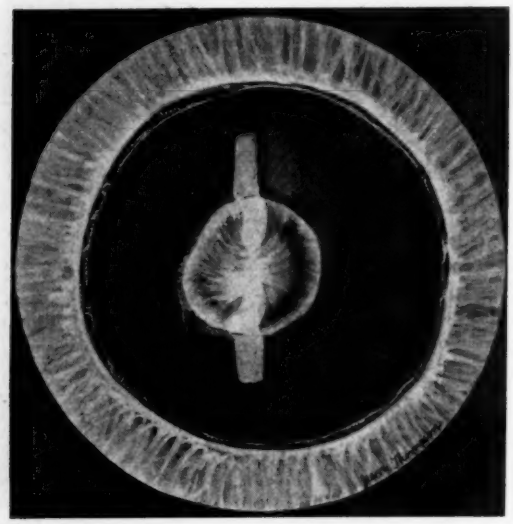

Fig. 8 (Cordes). Anterior polar (pyramidal) cataract.

2. Capsular flakes (Vogt-kapselstar-flecken). Meesmann[15] states that capsular flakes consist of white, oval or round, sharply circumscribed dense opacities that may be up to 1 mm. in size (fig. 9). They are frequently found associated with deeper opacities. The number of opacities varies but they are usually multiple. These opacities may appear as flat prominences on the capsular surface which, as Vogt[16] pointed out, make the affected area lose its normal shagreen when examined with the slitlamp. Pigment threads or star-shaped pigment debris are frequently found in the area of the opacities. Inasmuch as the opacities are rarely axial, they cause no visual loss.

3. Circular capsular or subcapsular cataract. As stated by Bellows,[17] circular capsular or subcapsular cataracts have been reported a number of times. The opacities vary in color from white, bluish white to "slightly brownish" in Gifford's[11] case. The opacities may be round or radially placed. Pigment deposits and persistent pupillary membrane may also be present. In Gifford's case the opacity was

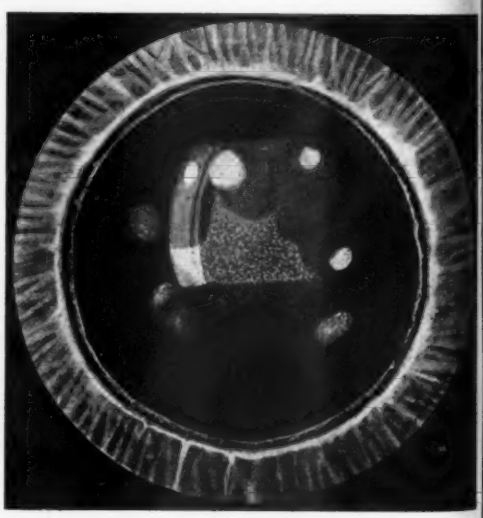

Fig. 9 (Cordes). Capsular flakes.

circular and subcapsular and measured 1.5 to 2 mm. in diameter. The opacities were closest to the capsule at the periphery and in the center showed a "depression like the crater of a volcano." The vision may be surprisingly good, and was found to be 20/30 in Gifford's patient (fig. 10).

Reduplication cataract

The development of this interesting form of anterior lens opacity has been described by Ida Mann.[19] This condition shows that there has been an intrauterine or, more rarely, postnatal injury or defect of the anterior capsule together with involvement of a few of the lens fibers which were in direct contact with it. The lens fibers laid down after the initial disturbance may be relatively normal and may grow between the degenerated portion of the cortex and the capsular changes. This process results in a localized opacity of the anterior capsule with a similar opacity below it, but separated from it by normal lens substance. It is possible to place the time of the original aberration by the depth of the reduplication from the lens surface (fig. 11).

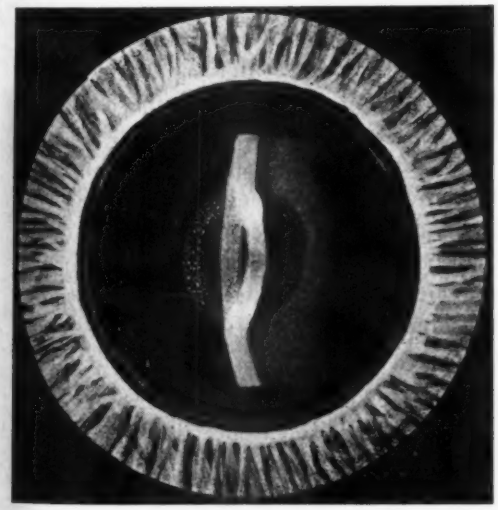

Fig. 10 (Cordes). Circular capsular or subcapsular cataract. (Reconstructed from Gifford. *American Journal of Ophthalmology*, 1924, volume 7, September, page 678).

Posterior polar cataract

The posterior lens dot representing the remnant of the attachment of the hyaloid artery is very common. At times there may be a large dense circular opacity covering the posterior pole, which represents a persistence of the fibrovascular sheath of the lens. Duke-Elder[20] feels that this condition can not legitimately be called a true cataract. A disturbance of the lens fibers directly beneath this may follow and in this way a localized posterior opacity may be formed corresponding to the anterior polar cataract.The opacity is confined to the capsule and the cortex just beneath it but it often causes marked interference with vision. When both eyes are affected, removal of the lens is indicated. Because of the fact that other anomalies are often present the prognosis must be guarded when surgery is considered.

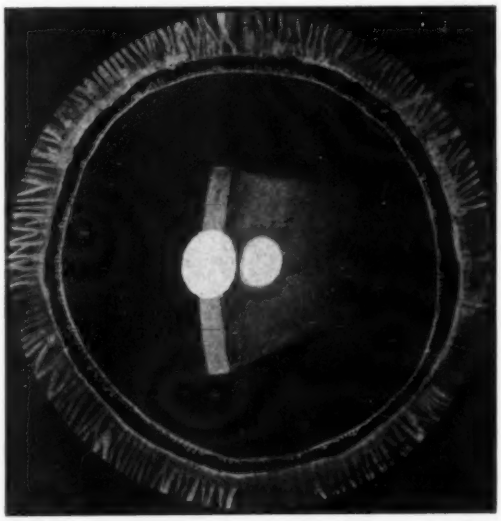

Fig. 11 (Cordes). Reduplication cataract.

Posterior lenticonus

Posterior lenticonus is a rare anomaly in which there is a conical or globular protuberance on the posterior lenticular surface. Von Szily[21] states that in addition to those cases in which there is an abnormal development of the posterior pole of an otherwise normal lens, there are some cases that are undoubtedly associated with the rupture of the posterior capsule. Vogt[22] found that 80 percent of the cases reported were complicated by posterior lens opacities, and, while persistent remnants of the hyaloid artery were by no means uncommon, they were situated slightly to the nasal side of the apex of the conus. The central part of the lens becomes highly myopic and causes dimness of vision. With the slitlamp, a ring reflex is seen which is often associated with a remnant of the hyaloid artery.

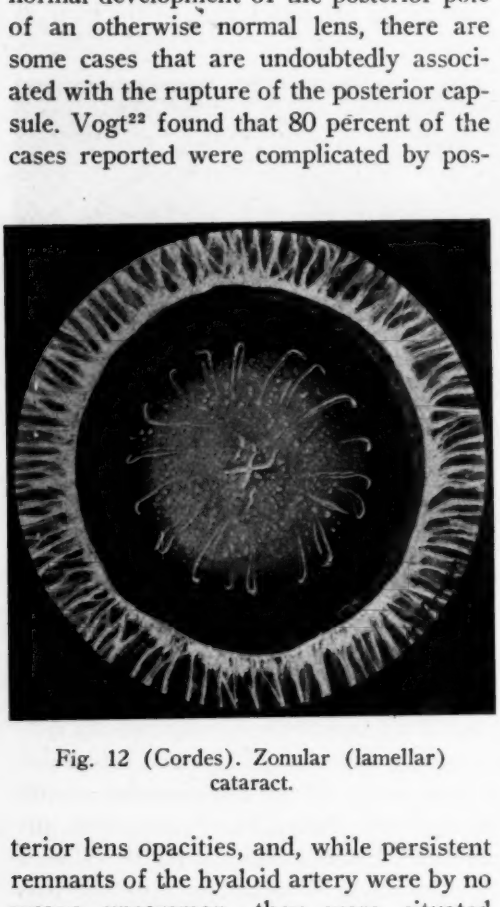

Fig. 12 (Cordes). Zonular (lamellar) cataract.

Zonular (lamellar) cataract

According to Jess[23] the zonular cataract (fig. 12) is one of the most frequent types of congenital cataract if we include the type that occurs within the first year of life. This cataract consists of a zone of lamellar opacities surrounding a clear, or almost clear, zone in the manner in which an orange peel surrounds the fruit. This zone of opacity is surrounded, in turn, by clear cortex. It is now a generally accepted fact that the opacity may occur either as a prenatal or a postnatal development. The size of the opacity varies and is dependent upon the state of development at the time of the lens damage; the earlier the disturbance the smaller the opacity. If involvement takes place at an early stage, the embryonic nucleus is surrounded by the opacity, but if it takes place during the last four months of pregnancy, the opacity will be within the fetal nucleus. Where opacification takes place after birth, the zone of the opacity will just surround the fetal nucleus.

The cataract appears as a round, gray, uniform opacity surrounded by a clear dark zone. It may be composed of fine white dots which according to von Szily[24] suggest a possible relationship to cataracta pulverulenta. There are thick, gray, radially placed U-shaped opacities, consisting of an anterior and posterior limb, that saddle the cataract in the equatorial region. At times, only part of the lens may be involved. Other parts of the lens may also be involved so that there may be fine punctiform opacities and opacification of the embryonic sutures. In addition, there may be a central embryonic nuclear opacity within the zonular opacity. At times there may be blossomlike opacities in the anterior portion of the cataract. The opacities have a tendency to increase in density rather than size and usually become stationary between 32 and 55 years of age. The size of the opacities has been given as between 5 and 8 mm. by von Bahr,[25] while von Szily[26] gives the figures as 2 to 8 mm. Von Arx[27] states that the thickness of the opacities varies between 0.5 and 0.7 mm.

There is a marked hereditary tendency, inheritance being usually of the dominant type. The condition is nearly always bilateral and there is, as a rule, equal involvement of the two eyes. The vision varies between hand movements and 20/30, depending upon the size of the opacities.

In some of the congenital cases, the disturbance continues until birth, or is so unusually severe that the entire lens may be opaque. Under these conditions further growth of the lens fibers does not take place. This type is usually associated with other congenital defects of the eye, and any operative prognosis must be guarded.

Bellows[28] classifies zonular cataracts into three groups: (1) The congenital type showing an hereditary predisposition. (2) The type associated with tetany, appearing either in the first years of life, or originating later in life as a result of parathyroid deficiency. (3) A form resulting from local eye disease or trauma.

1. Congenital type. It has been frequently demonstrated that zonular cataracts may be congenital and may show marked hereditary or familial tendencies. The transmission of the cataracts is continuous, only those individuals having the anomaly transmitting it; and it is transmitted by either sex and is not sex limited. Bellows[28] feels that the most probable explanation of formation is the possible occurrence of convulsions in the mother or fetus, as hypocalcemia or even tetany are not unknown in pregnancy. In addition, the formation of these cataracts may be related to the greater demand for calcium during the last three months of intrauterine life.

2. Type associated with tetany. This is the most common type of zonular cataract and its association with convulsions during the first year of life has been an established fact for many years. Although rickets was at one time considered the causative factor, tetany, has been established as the primary etiologic factor in the cataract development.

3. Resulting from local disease or trauma. The cataract has also often been observed after iritis, perforating corneal ulcer, contusions, and perforating injuries. Jess[29] reported the condition in a 13-year-old girl who, in the second year of life, had had a perforating injury with a needle.

As Hess[30] and others have pointed out,

Fig. 13 (Cordes). Embryonal nuclear cataract (cataracta centralis pulverulenta).

it must be remembered that the etiology of these lens opacities is not always the same. It must also be remembered that tetany can cause nuclear, cortical, or total cataract.

If the opacity too greatly interferes with vision, surgery is indicated for these cases and linear extraction seems to be the chosen operation. In cases where there is a presence of nystagmus, one must give a guarded prognosis as to vision.

Embryonal nucleal cataract (cataracta centralis pulverulenta)

Poos[31] and others believe that this cataract is related to the zonular cataract

for, even though it is smaller, the characteristics of zonular cataract may be present. Gifford[32] also felt there was some relationship between this form and coralliform cataracts. The cataract consists of a fine gray-white opacity (fig. 13) lying between the anterior and posterior Y sutures, the embryonal nucleus. This fact makes it apparent that the disturbance occurred in the first three months of intrauterine life. The opacity is seen as a small gray globe in the otherwise clear lens. Under the slitlamp, its appearance has been described as resembling particles of dust seen in the sunshine. Th condition is usually bilateral with a tendency for similar involvement in the two eyes. The condition is usually stationary, and the opacity measures 1.5 to 2.0 mm. The opacity may be rather dense.There is also a definite hereditary tendency. Nettleship and Ogilvie[33] found the condition in 20 members of one family. The cataract causes little interference with vision and Gifford[34] states that "operation is never required for opacity limited to the embryonal nucleus." Jess[35] observes that the embryonal nuclear cataract is often found in combination with the zonular cataract.

Total congenital cataract

According to Jess[36] this is a relatively rare form of congenital cataract. Hess[30] feels that it differs from the embryonal nucleal cataract and the zonular cataract only in that a larger portion of the lens is involved. In addition to complete opacification, there are some cataracts in which a small portion of the lens may remain relatively clear. At times there may be a shrunken cataract. Usually both eyes have the same degree of involvement, although, at times, one eye may have a total cataract and the other a membranous type. Total caatracts have been observed that did not become entirely opaque until after birth. Particularly in those cases where there has been a proliferative process of the tunica vasculosa, there is a tendency for later cataract development. The cataract may degenerate to the point of liquefaction so that it resembles a hypermature Morgagnian cataract. Even though the changes have taken place in intrauterine life, Mann[37] feels that the cause is probably a metabolic one which occurs near the end of fetal life.

Membranous cataract

Jess[38] states that these cases are genetically related to total cataract. With absorption of the lens parenchyma during intrauterine life, the anterior and posterior capsule collapse to form a thin gray-white or chalky-white membrane. The presence of a deep anterior chamber associated with iridodonesis helps to make an easier diagnosis. The condition is frequently bilateral and often associated with other anomalies and with nystagmus and strabismus. In some cases there has apparently been an intrauterine iritis. Congenital lues has also received consideration as an etiologic factor. In a few cases the rupture of the posterior capsule has been demonstrated. While the condition is usually not considered to be hereditary, I have seen three members of one family with the same condition. In each case discission of the membrane resulted in useful vision, although all three had nystagmus.

Floriform cataract

In 1923 Koby[39] described a rare form of congenital cataract to which he gave the name floriform (fig. 14). The opacity takes the form of annular elements, arranged either independently or grouped together like the petals of a flower. They are most commonly found in the axial portions of the lens, especially in the region of the fetal sutures. The condition shows a familial tendency, Koby report-

ing one family in which the mother and four children were affected. According to Meesmann[40] the opacities which are not visible in direct light are bluish-white to yellow as seen with the slitlamp.

Axial fusiform cataract (spindle cataract)

This cataract (fig. 15) was first described by Knies[41] in 1877. The usual type consists of anterior and posterior polar cataracts united by threadlike opacities extending axially through the lens. According to Jess[42] sometimes only the anterior or posterior part of the spindle may be present. The degree of interference with vision varies according to the amount of opacification present. The fusiform cataract is usually bilateral and the two eyes show equal involvement. This

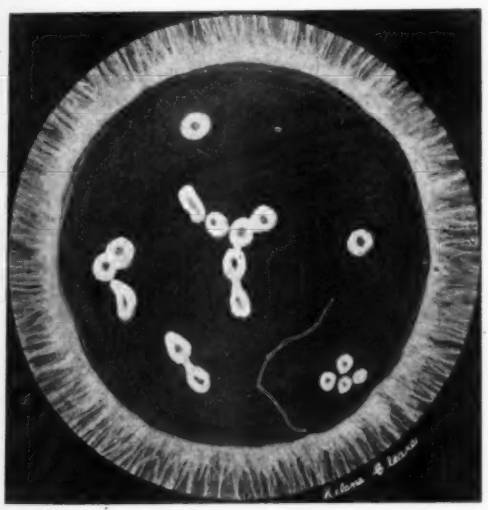

Fig. 14 (Cordes). Floriform cataract. (Drawn from Bellows. *Cataract and Anomalies of the Lens,* St. Louis, C. V. Mosby Co., 1944, page 274).

type of cataract shows a definite hereditary tendency. Embryonal nuclear, lamellar, and axial fusiform cataracts have been observed in the same family. An actual adhesion of the nucleus to the anterior and posterior capsule has been demonstrated by Collins[43] and others. Duke-Elder[44] feels these cataracts result from some disturbance in early fetal life which affects the axial area of the lens and interferes with the growth of new lens fibers in this region.

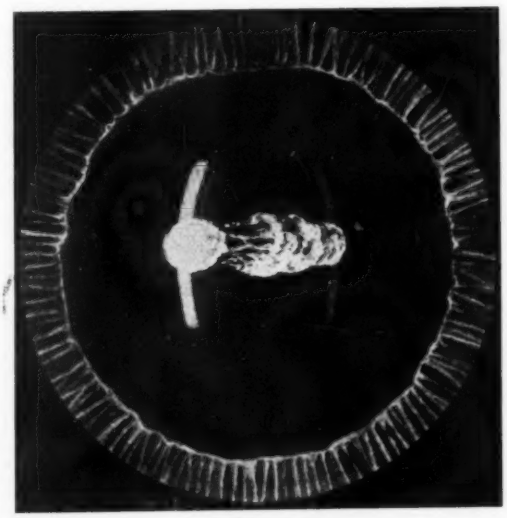

Fig. 15. (Cordes). Axial fusiform cataract (Spindle Cataract).

Coralliform cataract

Coralliform cataract was the name given by Gunn[45] in 1895 to this unusual type of hereditary cataract. He described the cataract as composed of "rounded and oblong grey and white opacities seen grouped toward the center of the lens, so as to resemble a piece of coral growing forwards and outwards from this point." The condition has also been described by Nettleship,[46] Gifford,[32] and others. In 1937 (fig. 16), Gifford and Puntenney[47] reported another case in which "irregular stellate or flower-shaped opacities extended forward to the anterior capsule and backwards to the posterior capsule, being connected with similar branching opacities involving all the layers of the lens in the axial area." The condition has a definite hereditary tendency, Nettle-

ship[46] having found 35 persons involved in five generations of one family.

Verhoeff[48] examined one of these lenses microscopically and found large masses of

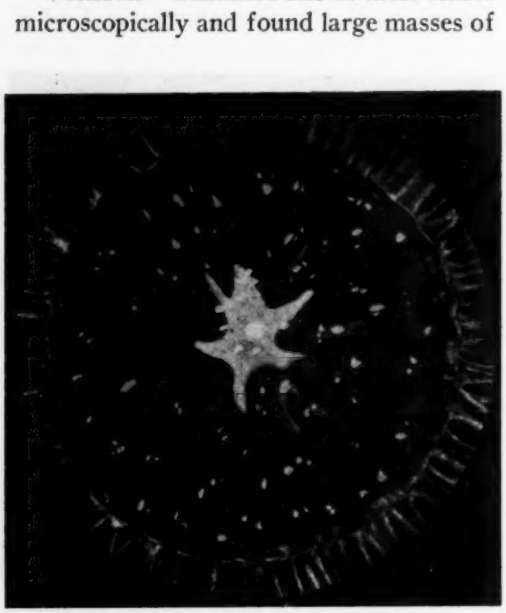

Fig. 16 (Cordes). Coralliform cataract. (From Gifford and Puntenney. *Archives of Ophthalmology*, 1937, volume 17, page 885).

crystals surrounded by areas of alterations in the lens fibers. The crystals consisted of rectangular and rhombic plates which showed the microchemical reaction of protein. These findings were confirmed by a case of Zentmayer's.[49] Nettleship assumed these cataracts to be identical in nature with spindle or fusiform cataract. Verhoeff[48] however, feels that the striking coral-like appearance and the distinctive crystals favor the opinion that the condition is entirely distinct from spindle or fusiform cataract. More recently, Mann[50] has grouped them all together and states that the axial fusiform cataract may arise by undue adhesion of the primary lens fibers to the anterior and posterior capsule while coralliform cataract involves the earliest secondary lens fibers which, failing to meet to form the anterior suture, remain wide open.

Spear cataract

Vogt[51] described a type of cataract that he called "spear cataract" (fig. 17). In his case, spiky, branching opacities were seen running through the axial portion of the lens with no apparent relation to its anatomic structure. In places these opacities resembled insects; in other places the needlelike opacities showed a play of colors. In some instances, the crystals measured a millimeter in length and were arranged in bundles similar to tyrosine crystals. One lens which was extracted showed a predominance of cystein on chemical analysis. Gifford[18] had a similar case in which the opacities were more regularly arranged so that they had the appearance of "two conventional fir trees placed base to base, the bases occupying the center of the lens." In 1937 Gifford and Puntenney[47] reported a case (fig. 18) in which the opacity was composed of crystals which resembled those of a spear cataract but were arranged in a more compact and circular mass. The central mass was just anterior to the anterior Y. A thin layer of cortex was present anterior to the outer zone of the crystals. The crystals were

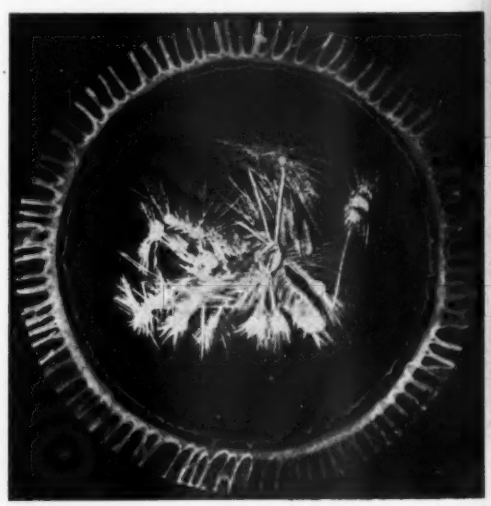

Fig. 17 (Cordes). Spear cataract of Vogt. (Drawn from Vogt, A. *Archiv für Ophthalmologie*, 1922, volume 107, page 237).

those of calcium sulfate. Gifford[32] feels that these are all varieties of the congenital axial group of cataracts and states[47] that the reports indicate that chemical changes may occur in lenses belonging to the coralliform group that result in the formation of crystals in the lens.

Spirochetelike cataract

Koeppe[52] reported in 1921 an unusual type of congenital cataract that was bilateral and had fine lens opacities scattered through the lens. In the adult nucleus were some radiating opacities. The posterior pole showed an ill-defined disciform, conical opacity with its blunt tip directed toward the nucleus. In this area of the lens were numerous spirochetelike or corkscrewlike gray opacities that varied in size and thickness. During a 4½-year period of observation no change could be discerned (fig. 19).

Disc-shaped or ring cataract

This rather rare and unusual congenital cataract, resulting from the absence of the embryonic nucleus, has been described by Riedl,[53] Vossius,[54] Collins,[55] von Szily,[56] and others. The cataract consists of a depressed opaque central area surrounded by a clear lens of normal size and thickness and forms a closed ring that has been described as resembling a life preserver (fig. 20). The depressed area in the center is not a hole, and there is no free communication between the anterior and posterior chamber. The central defect varies in size but never exceeds the diameter of the embryonic nucleus. In section, it appears as a dumbbell, having two lateral masses connected by a central band. In the pathologic examination of Haro's case[57] "the lens resembled a doughnut with a central, thinned, membranous area, 2.5 to 3 mm. in diameter, which was grey-white. The surrounding ring structure possessed the body of lens substance but showed yellowish opacities extending from the membranous portion toward the equator." In section the central area representing the axial portion was reduced to a membranous band about 0.5 mm.

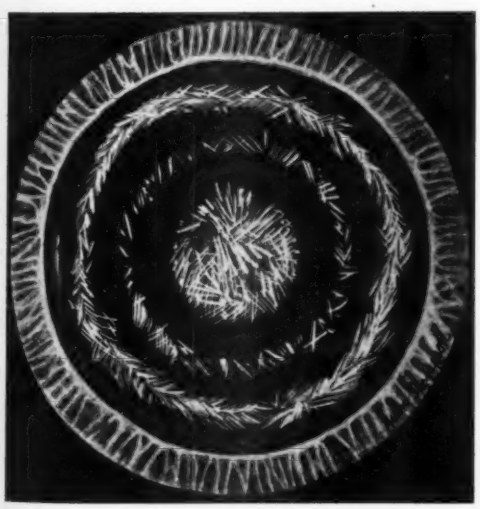

Fig. 18 (Cordes). Opacities composed of crystals resembling the spear cataract. (From Gifford and Puntenney. *Archives of Ophthalmology*, 1937, volume 17, page 885).

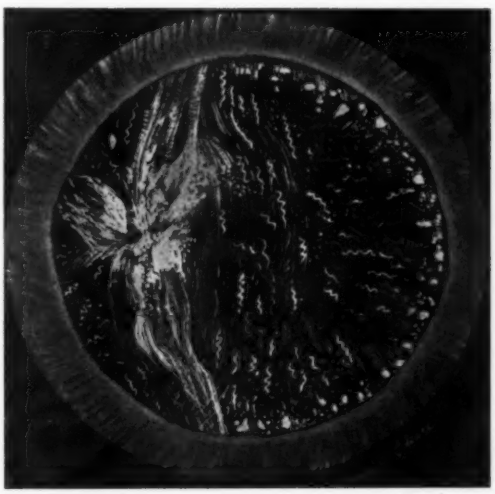

Fig. 19 (Cordes). Spirochete like lens opacities. (Modified drawing from Koeppe, L. *Klinische Monatsblätter für Augenheilkunde*, 1922, volume 69, page 482).

thick, composed anteriorly of an intact, folded glass membrane. "A wavy glass membrane could be followed along the posterior surface from each outer margin but appeared to be absent or poorly formed centrally. Between these two membranes was a groundwork of a pale

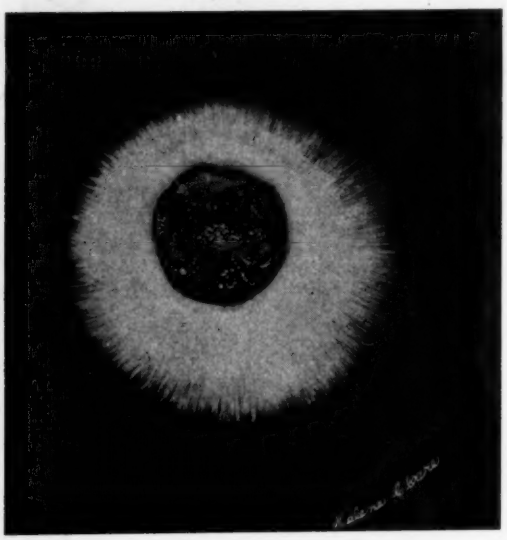

Fig. 20 (Cordes). Ring (disc-shaped) cataract (Modified drawing from von Szily, *Klinische Monatsblätter für Augenheilkunde*, 1928, volume 81, page 145).

eosinophilic, slightly fibrillar mass, in which could be found fusiform cells occurring in clumps."

While the lens substance within the ring is usually clear, there may be a zone of opacification resembling a zonular cataract.

There is a definite hereditary tendency in this condition; von Szily[56] has reported a family in which four members were affected. Haro[57] observed a family of 59 individuals covering four generations in which 16 members had congenital cataracts. In all members examined the cataract was of the disc-shaped type. Of this cataract, Ida Mann[58] says that the most logical embryologic explanation is that the nucleus, having failed to develop, shrinks and calcifies and remains adherent to the capsule so that the outer fibers cannot grow around it but merely plaster themselves to the equatorial region. However, the initial cause is still unknown.

Aside from the congenital, familial disc-shaped cataract, there is another form described by Vossius,[54] Goldfeder,[59] Marchesani,[60] Wessely,[61] and others; this is the so-called Soemmerring's ring. These cataracts may follow discission, corneal perforation, and, above all, perforating ulcers. The damage to the capsule must occur in the center of the lens during youth when the nucleus is still absorbable.

There are various surgical treatments for these cases. In many of these cases where the remainder of the eye is normal, a discission of the central membrane is usually sufficient. Collins,[43] in one case, was able to separate the central plaque, which fell into the anterior chamber where it remained without reaction. In two of his cases, Haro[57] found the membrane so tough that it was necessary to make a keratome incision and cut the central membranes with de Wecker scissors. Total extraction must be considered with caution because of the fact that in some of these cases the central plaque is adherent to the hyaloid membrane.

Congenital cataract after rubella (German measles) in the mother

In May of 1944, Reese[62] reported three cases of congenital cataracts in infants born of mothers who had rubella in the first month of pregnancy. This report followed the original ones of Gregg[63] and of Swan and his co-workers[64] when an epidemic of rubella in Australia called the prevalence of this condition to their attention. Since that time, over 200 cases have been reported and now the entity is well-established. I have never been able to find one instance of lens abnormalities where

the rubella was contracted after the third month. Typical findings personally observed in a child, aged nine years, suggests that the condition is not a recent one.

In addition to having lens changes, these children are small, ill-nourished, and difficult to feed. A high percentage show cardiac defects (Gregg's series, 43 percent[63] and in Prendergast's series, 40 percent).[65] There is intolerance to atropine together with an inability to dilate the pupil. These babies are prone to pneumonia and may run a temperature of 105° to 106°F. A fairly high percentage show mental deficiency and microcephaly.

Two main types of cataract are observed. In the first type, there is a pearly-white central opacity with a smaller, clearer peripheral zone. In the second type, the entire lens is opaque. The process involves all but the outermost layers of the lens and is considered to have begun early in embryonic life.[62] The condition is usually bilateral; in three cases personally observed, the noncataractous eye showed pigment changes in the retina. This has also been observed by Prendergast,[65] Terry,[66] and others.

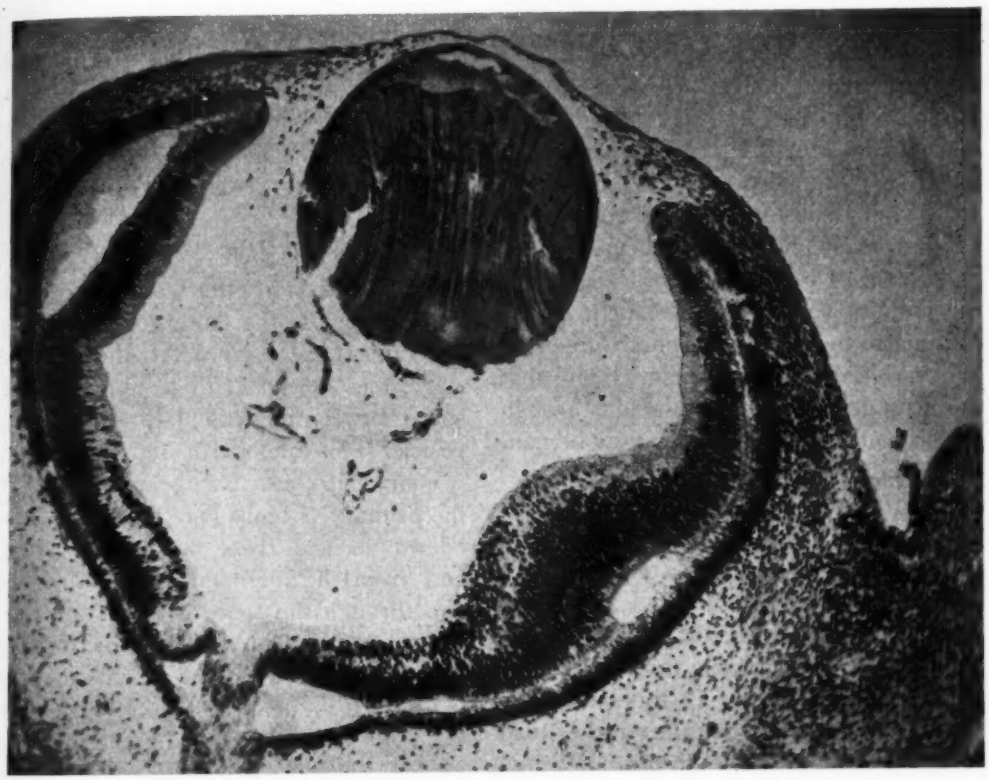

Fig. 21 (Cordes). Section of eye of 7- to 8-week-old embryo with history of rubella during the fifth week of pregnancy, showing retardation in development of lens. (Cordes and Barber. *Archives of Ophthalmology,* 1946, volume 36, August, page 135.)

In addition to cataracts, nystagmus, strabismus, corneal opacities, microphthalmus, and glaucoma have also been observed.[67]

Surgical results in these cases have been only fair, one of the problems being an inability of dilatation of the pupil. In microphthalmic eyes the results have been poor.

Not without interest is the microscopic examination of the eye of a 7- to 8-week-old embryo with a history of rubella during the fifth week of pregnancy, as reported by Cordes and Barber.[68] This lens (fig. 21) showed definite retardation of development and differentiation while the posterior segment was normal. Terry,[66] in comparing the specimen with those in the Minot Embryological Collection at Harvard, stated that the lens showed the differentiation and size of a 17-mm. embryo, while the differentiation and over all size corresponded to the 19-mm. stage. Ida Mann[69] substantiated the retardation of the development of the lens. Cordes and Barber[68] offer, as a possible theory, the limitation of the development of the cataract to the first three months of pregnancy. Needham[70] has pointed out that the ultrafiltrable viruses can pass through the placenta into the amniotic fluid in man. Erickson[71] mentions the fact that embryonic tissues are particularly susceptible to virus infection. During the first three months Descemet's and Bowman's membranes have not formed to protect the lens vesicle; thus, the toxic agent in the amniotic fluid is able to act fairly directly on the lens during this time. The growth of these barriers after the third month may explain the absence of initial lens changes after that time. Swan[71-a] reported a 2½-month-old fetus with a history of rubella in the second month. Examination revealed unilateral cataract with lack of closure of the fetal fissure.

Persistence of tunica vasculosa lentis

Retrolental fibroplasia (Terry); Persistence of tunica vasculosa lentis; persistence and hyperplasia of the primary vitreous (Reese and Payne)—these and many other terms all apply to an abnormality which, while strictly speaking is not a cataract, is so closely associated with the lens that it warrants our consideration. The condition has been reported many times in the past as a unilateral lesion found at the time of birth in full-term infants. Gifford and Latta,[72] in 1923, stated that cases of extensive persistence of the tunica vasculosa lentis were "not very rare." As a result of Terry's work,[73-77] the condition has been called to our attention as an entity consisting of a bilateral lesion of premature infants. The increase of frequency is probably the result of the decrease of infant mortality during the last decade.

Embryology of the vitreous

To understand the condition, some knowledge of the embryology of the vitreous is necessary. At the 4.5-mm. stage, mesoderm begins to appear in the space between the lens plate and the optic vesicle. This mesoderm starts from the primary vitreous. By the 10-mm. stage the primary vitreous is composed of mesoderm derived from the hyaloid artery and from the mesoderm that enters the cup through the space between the anterior rim of the cup and the lens, together with ectoderm which is composed of fibrils from the lens and the inner wall of the optic cups. At the 13-mm. stage, the hyaline capsule surrounding the lens is completely formed so that the lens no longer contributes to the development of the vitreous. The capsula perilenticularis fibrosa is now formed by condensation of the fibrils adherent to the lens and derived from the lental part of the primary vitreous. During this period the hyaloid artery begins to send branches through the capsula perilenticularis fibrosa to form the tunica vasculosa lentis. This completes the development of the primary vitreous, consisting of ectoderm derived from the lens and retina and of mesodermal vasoformative tissue which has formed the hyaloid artery, the posterior

and lateral portions of the tunica vasculosa lentis. With the development of the secondary vitreous from the retina, the primary vitreous persists as a funnel-shaped area with its wide end at the posterior surface of the lens. The condensation line between the primary and secondary vitreous forms the "wall" of Cloquet's canal.

At the 60-mm. stage (11 weeks) the vessels begin to regress and by 8½ months all vessels except the main trunk have atrophied completely. Toward the end of fetal life the mesodermal part of the vitreous disappears and the permanent vitreous is exclusively ectodermal in origin.

Clinical Course and Appearance

The condition, present in 12 percent of all premature babies weighing three pounds or less, makes its appearance 4 to 6 months after birth as a gray-white membrane behind the lens. It may cover the entire lens surface or only part of it (fig. 22). Blood vessels of varying size and number are usually visible. The membrane is densest in the central area and in some cases thins out to such a point at the periphery that the fundus is visible. Terry[77] and Reese and Payne[78] report that very long, narrow ciliary processes which go to the edge of the membrane or are free can be seen around the equator of the lens. The condition is almost always bilateral. In one case personally seen, there was a persistent pupillary membrane consisting of the ghost vessels of the anterior part of the (fig. 23) tunica vasculosa lentis. These cases have a tendency to develop cataracts; and glaucoma is also a common finding.

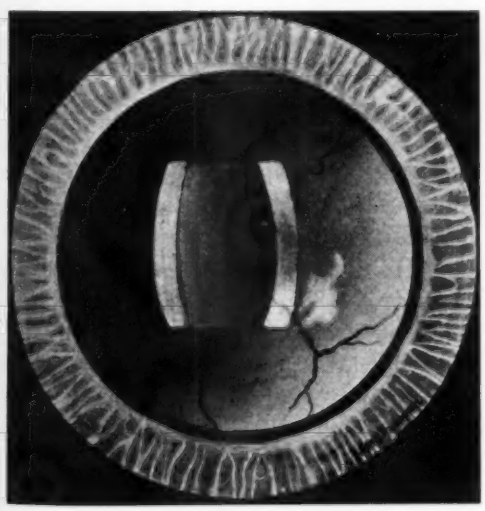

Fig. 22 (Cordes). Clinical appearance of retrolental fibroplasia.

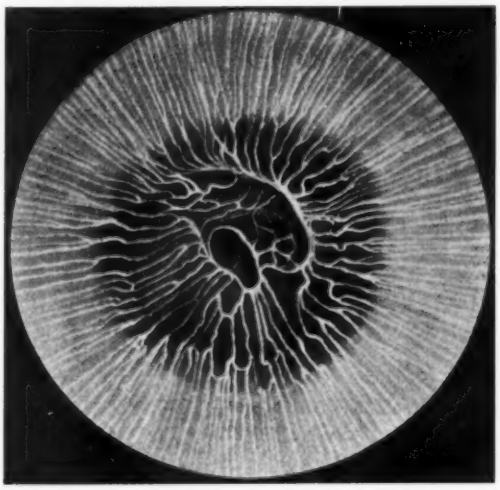

Fig. 23 (Cordes). Pupillary membrane rests (persistence of remnants of anterior part of tunica vasculosa lentis) associated with a case of retrolental fibroplasia.

Histologically, the posterior surface of the lens is observed to be covered by a dense fibrous tissue. Frequently, one sees clinically that the ciliary processes are elongated and attached to the connective tissue. This was also noted by Gifford and Latta.[72] In some cases the central hyaloid artery, in the form of a cord of thread, is seen to extend to the posterior surface of the mass. Microscopically the tissue shows embryonic connective tissue and persistent fetal fibrillar vitreous; the

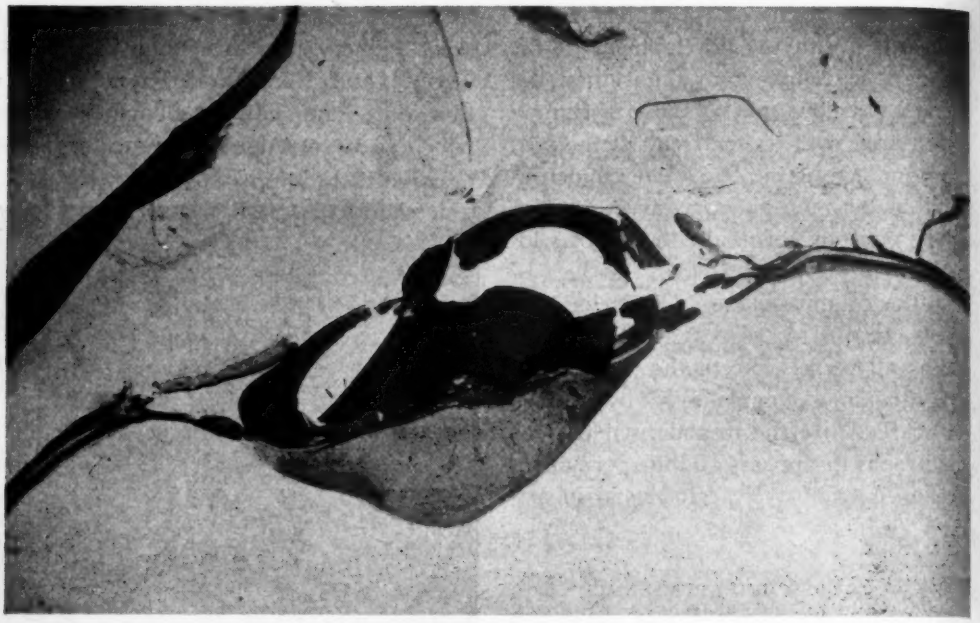

Fig. 24 (Cordes). Section through lens with retrolental fibroplasia (Dr. T. L. Terry).

fibrous tissue being rather rich in blood vessels (fig. 24).

Detachment of the retina is a fairly common occurrence in these cases. Reese and Payne[78] felt that the formation of the secondary vitreous plays a role in this condition. If the fibrous strands of the primary vitreous remain adherent to the inner surface of the retina then, when the secondary vitreous forms, the retina may be detached. All degrees of this process may be seen and in some of the cases the entire retina was detached and adherent to the retrolental mass.

Terry[76] feels that the condition is primarily a persistence of the tunica vasculosa lentis with hypertrophy. Reese and Payne,[78] on the other hand, look upon the condition as being a persistence in part or in toto of the primary vitreous with or without hyperplasia. They class the above lesion as one of four types of clinical manifestation of the condition. Haden[79] would seem to support this contention when he says that "toward the end of fetal life very little of the primary vitreous remains. Sometimes, however, this primary vitreous fails to absorb and the mesodermal part develops into fibrous connective tissue, and a firm triangular, opaque mass is formed behind the lens." He further states[80] that the size, position, and style of the lesion is influenced by the fetal age at which the normal recession of the primary vitreous ceased.

In the differential diagnosis only two conditions deserve serious consideration; retinoblastoma and pseudoglioma. The nine cases on which Reese and Payne[78] did X-ray studies were all negative for calcium. Transillumination is good in these cases. The most important diagnostic points include first an opaque mass behind the lens that has an anterior concavity; and, secondly, long ciliary processes that can be seen around the edge of the lens. In addition, the history of most cases shows a premature birth. In most instances the lesion is bilateral.

Surgery and radiation have both been

employed in these cases but the results have been very unsatisfactory.

Encephalo-ophthalmic dysplasia

Krause[81] recently presented 18 cases under the title of congenital encephalo-ophthalmic dysplasia. The ocular disease was similar to, or identical with, retrolental fibroplasia of Terry or the persistence of the primary vitreous of Reese and Payne. This dysplasia was more commonly found in premature infants and in infants from a multiple birth. The common neurologic signs were mental retardation, microcephalus, and hydrocephalus. Clinically, the ocular disease rarely occurred without neurologic signs of involvement of the brain when the child was examined after the age of four years.

The ocular signs were loss of vision, ptosis, endophthalmos, microphthalmos, strabismus, retinal detachment, retrolental masses, retinal atrophy and gliosis, retinal dysplasia, coloboma of the choroid and optic nerve, recurrent hemorrhages in the retina and vitreous, secondary glaucoma, and cataract.

Reese[82] in the discussion of Krause's paper felt it was the same condition described by Terry, and by Payne and himself. Terry called the lesion retrolental fibroplasia and concluded it was an acquired manifestation. Reese and Payne designated the lesion as persistence and hyperplasia of the primary vitreous. Krause believes the lesion represents a faulty development of the neuroectoderm in that portion where it forms the retina as well as the brain. Reese further stated that he felt the incidence of mental retardation was no higher than in the series of cataract associated with rubella and did not believe that Krause's findings justified the assumption that mental retardation is a usual accompaniment of the ocular lesion. Future studies will probably clarify the picture.

Comments

From the foregoing, it is apparent that there is a wide variety of congenital cataracts.

It is well known that certain types have a hereditary tendency. Franceschetti[83] has listed the following as types with an hereditary tendency: congenital total cataract, lamellar cataract, embryonal nuclear cataract, coralliform cataract, spear cataract, floriform cataract, anterior axial embryonal cataract, anterior and posterior polar cataract, axial fusiform cataract, stellate cataract, and disc-shaped cataract.

Intrauterine trauma may at times produce lens changes as seen in the reduplication cataract.

As Ida Mann has pointed out,[84] we know experimentally that toxic substances administered to the mother during pregnancy may cause lens changes. It is known that interference with calcium metabolism and parathyroid secretion will produce the same opacities as will avitaminosis.

Recent work that has been done on rubella cataract has shown that infection in the mother is capable of producing cataracts. The section through the eye of a seven-weeks embryo with a history of rubella in the mother during the fifth week of pregnancy would seem to bear out the contention that the damage is done at the time of the infection.

In addition to the changes in the lens substance itself, there may be abnormalities of the vascular capsule, which is mesodermal, and which may cause such changes as retrolental fibroplasia, persistence, and hyperplasia of the primary vitreous. This is often associated with changes in the lens itself.

In conclusion, as Ida Mann[82] points out, it must be remembered that the lens is transparent in its normal development and, therefore, all congenital lens opacities are pure aberrations and not arrests.

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THE TREATMENT OF LEWISITE AND OTHER ARSENICAL VESICANT LESIONS OF THE EYES OF RABBITS WITH BRITISH ANTI-LEWISITE (BAL)*

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At the beginning of the war, in 1939, work on the mode of action of and possible antidotes for the vesicants likely to be used in chemical warfare was initiated by an extramural research team (supported by the Chemical Defence Research Department of the Ministry of Supply) in Oxford under the direction of Prof. R. A. Peters. Peters, Stocken, and Thompson (1945) have described the preparation of the new compound 2:3 dimercaptopropanol (BAL) and its action as an antidote to the arsenical vesicants, and the reader is referred to this paper for details. The present paper describes experiments undertaken by the authors to determine the effect of BAL on lesions produced by Lewisite and other arsenical vesicants on the eye of the rabbit. The work was begun in 1941 at the laboratories of the Imperial Cancer Research Fund and was completed at Oxford. It was supported throughout by the Chemical Defence Research Department of the Ministry of Supply.

The action of BAL in averting, aborting, or reversing the destructive effect of Lewisite burns of the eye is so striking and can be so well-observed in the rabbit that it is worthy of recording in detail. No similar therapeutic effect on a destructive lesion of the eye is known, and the pathologic principle involved is a new one. Arsenicals are known to combine with thiol compounds, and Voegtlin (1923) suggested that the toxicity of arsenic lay in its ability to combine with the —SH groups of compounds, such as glutathione, which are essential in cell metabolism. Stocken and Thompson (1941) analyzed the compound of Lewisite and keratein, a protein containing many thiol groups, and they found that each Lewisite molecule combined with two thiol groups. This led them to prepare the dithiol compound 2:3 dimercaptopropanol (BAL) as a soluble penetrating "chaser" for Lewisite in the tissues. BAL combines with Lewisite readily to form a relatively stable compound and, therefore, competes with tissue proteins and other —SH containing compounds for any Lewisite present. It penetrates the eye tissues with great rapidity, and the resultant compound of BAL and Lewisite is relatively harmless and capable of excretion through the kidneys. BAL reacts with Lewisite on the cell surface or within the cell itself and a most striking reversal of an intracellular destructive pathologic process can be observed. The eye is particularly suitable for demonstrating this new type of therapeutic reaction because of the ease with which changes in the eye can be observed over a long period of time by the aid of slitlamp microscopy.

METHODS

Rabbits were used in all experiments. They were mainly of mixed Dutch stock, chosen for eye color. They were housed in individual cages and fed a mash of bran, toppings, and sugar-beet pulp, together with fresh greens each day. Care was taken to use young, healthy animals as it was necessary to watch their eyes

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over a long period. A total of 150 eyes was used.

The experiments may be divided into five essential groups:

1. Effect of BAL itself on the normal eye.
2. Effect of Lewisite alone on the normal eye.
3. Effect of BAL on eyes injured by Lewisite.
4. Effect of BAL on eyes injured by other arsenicals.
5. Effect of BAL on eyes injured by a mixture of Lewisite and dichlorodiethylsulphide (mustard gas).

Results

1. Effect of BAL itself on the normal eye

The effects of solutions of BAL of various strengths can be expressed briefly in tabular form, as they vary roughly with the concentration (table 1).

TABLE 1

Effect of BAL itself on the normal eye

Strength of Solution (BAL in Thiodiglycol,	Method of Application	Time (After Application)	Changes Observed
1 percent	One drop in eye	5–15 min.	Very slight contraction of pupil; no other change
	Continuous eye bath for 15 min.	5–15 min.	Pupil contracted; conjunctiva congested; epithelium damaged; recovered in a few hours
5 percent	One drop in eye	5–15 min.	Slight contraction of pupil; no other change
	Continuous eye bath for 15 min.	5–15 min.	Contraction of pupil; damage to epithelium, ?to substantia propria; flushing of iris; complete recovery
10 percent	Continuous eye bath for 15 min.	1–24 hr.	Contraction of pupil; corneal haze; chemosis; iritis
		4 days	Deep corneal vascularization
		12 days	Retrogression of vessels
		15 days	BAL dots* visible
20 percent	Continuous eye bath for 15 min.	1–24 hr.	Severe reaction with corneal haze, chemosis, and iritis
		4 days	Vascularization
		4–30 days	Acutely inflamed
		3 months	Healed with irregular vascular scar
25 percent	Single drop in eye	Immediate	Surface corneal opacity and contracted pupil
		24 hr.	Slight iritis and corneal edema
		10 days	Eye clear
		15 days	BAL dots*
30 percent	Single drop in eye		Similar to 25% solution
Undiluted BAL	Single drop in eye		Similar to 25% solution but may leave slight permanent nebula

* BAL dots are described in detail on page 423.

BAL dots. The appearance referred to (Table 1) as "BAL dots" was first visible on the 15th day after treatment of the eye with 10- to 30-percent solutions of BAL. It consisted of a series of opaque white and glistening dots visible with the slit-lamp in the area of maximum previous disturbance of the substantia propria; namely, the center of the cornea. These dots were evenly distributed under the epithelium within the superficial third of the substantia propria, and were visible by internal illumination (sclerotic scatter), as well as by direct (broad and narrow beam), and by retro-illumination. They were about the size of a corneal corpuscle and were of various shapes, ring forms, horseshoes, and short rods alternating with round dots. Their nature was investigated by cutting frozen tangential sections of the cornea, staining with hematoxylin and examining with an oil-immersion lens. They were then seen to be deposits of a hyaline, amorphous material in various sized granules lying within the cytoplasm of invading macrophages. Their exact nature is unknown and, so far, they have only been seen after application of BAL. They are not of any clinical importance. They remain stationary for a long time, but may change their position owing to the migration of the macrophages carrying them. In one eye, they were observed for 10 months; in another, for 14¾ months. They usually begin to thin out and to occupy a larger area in two to three weeks after they are first observed. If they have been first observed in a central clump, they will, by four or five months, have migrated peripherally so that they form a widely dispersed ring not quite half way to the limbus. In some cases, they spread out and disappear entirely within a year, in others some traces remain for at least 15 months.

It is thus evident that continuous application for 15 minutes (as an eye bath) of a large amount of BAL in strengths varying from 5 percent to 20 percent is harmful, but that a single drop of a 30-percent solution can be used with safety. In subsequent therapeutic experiments, 10-percent and 20-percent solutions were generally used. The exact strength within these limits appears to be immaterial, although there is a slight balance in favor of 20 percent. Both stronger and weaker solutions than these are also effective in the presence of Lewisite. The action of pure BAL on an uncontaminated eye was also investigated and found to be similar to that of a 30-percent solution, but unlike this, it leaves a very slight permanent nebula.

2. Effect of Lewisite alone on the normal eye

In order to judge the therapeutic action of any substance, it is necessary to be able to produce a standard lesion, the course of which, if untreated, can be predicted with certainty. Any alteration in this course can then with safety be put down to the effect of the treatment given. We, therefore, attempted to produce standard lesions with Lewisite vapor and with liquid Lewisite.

It was found impossible to produce standard lesions with Lewisite vapor with the means at our disposal, so that liquid Lewisite was adopted in practically every case. Contamination by a 0.1 to 0.2 mg. droplet of Lewisite was used, since this produced complete destruction of the eye in every case. The exact site of application of the droplet of Lewisite made no difference to the end result; namely, destruction of the eye. The course of events leading to this could, however, be slightly modified by different techniques of application.

Thus, if the droplet were placed on the center of the cornea of an anesthetized

rabbit and the eye was carefully held open so that the lids did not come in contact with the cornea for 15 minutes, the eye was lost by shrinking after a stage of vascularization of the cornea (central control lesion).

If, on the other hand, the rabbit was allowed to blink immediately after the application, so that the Lewisite was spread over the cornea, conjunctiva, and lids, destruction was more rapid and complete, the cornea perforating before any vascularization had taken place. This type of lesion simulated that to be expected from a droplet of Lewisite spray entering the eye in warfare or in a factory accident, and was known as the splash-and-blink control lesion. Both this and the central control lesion were used in testing the efficacy of BAL, since the central lesion allowed of more detailed observation of the course of the antidotal action; while the splash-and-blink lesion simulated more nearly that expected in war.

The course of events following these two types of lesion can be summarized and used for comparison with the treated series* (tables 2 and 3).

It is thus obvious that Lewisite leads immediately to gross edema and ends in complete destruction of every cell with which it comes in contact. It penetrates the tissues rapidly and exerts an almost immediate effect on the intraocular tissues as well as on the surface cells.

TABLE 2

CENTRAL CORNEAL CONTROL LESION WITH 0.1 TO 0.2 MG. LIQUID LEWISITE

Time	Lids and Conjunctiva	Cornea	Iris
Immediate		Central opacity	
2–5 min.	Lacrimation		Pupil strongly contracted
20 min.	Severe edema of lids and conjunctiva		
3 hr.	Extreme chemosis and hemorrhages	Corneal epithelium shed. Edema of substantia propria all over	
24 hr.	Chemosis and lid swelling much better. Large conjunctival hemorrhages	Staining all over with fluorescein	Severe exudative iritis
3 days	Very little discharge	Corneal epithelium healing	Severe iritis
6–8 days	Very little discharge	Epithelium healed. Uniform marginal vascularization of cornea. Vessels reach center of cornea	
3 weeks	Slight mucopurulent discharge	Separation of central slough or central perforation	Depigmentation of iris
6 weeks	Eye shrinking	Proliferation of limbal pigment	Anterior synechiae. Pupil blocked with cyclitic membrane

3. EFFECT OF BAL ON EYES INJURED BY LEWISITE

Studies of the course of such standard

* For a detailed description of the clinical pathology of Lewisite lesions of varying severity see Mann, Pirie, and Pullinger, "A Study of Lewisite Lesions of the Eyes of Rabbits." This JOURNAL, October, 1946.

Lewisite lesions treated with BAL at varying times after contamination revealed that the destructive effect could, under certain conditions, be entirely prevented.

This is demonstrated in Figures 1 to 12. Figures 1 to 6 show the stages of destruction in an untreated splash-and-blink lesion. Figure 7 shows one untreated (control) eye and one apparently normal eye. This apparently normal eye had received the same dose of Lewisite, plus one drop of 20-percent BAL in thiodiglycol applied immediately after the Lewisite. This shows in a very striking manner the complete protection afforded. Figure 8 shows an intermediate stage of cure of a similar eye; the cornea was still slightly edematous in two days, but normal in three. Figure 9 shows an equally good result obtained by waiting five minutes before applying the BAL. Figure 10 shows an eye in which treatment was delayed for 10 minutes. In this case, the eye became normal, but in similar cases seen in Figures 11 and 12 some permanent depigmentation of the iris remained, although the eyes were functionally perfect. These photographs show that we are dealing with a very remarkable reversal of a destructive lesion. The clinical changes must be dealt with in some detail as the pathologic reaction involved is unusual.

TABLE 3

SPLASH-AND-BLINK CONTROL LESION WITH LIQUID LEWISITE

Time	Lids and Conjunctiva	Cornea	Iris
Immediate	Lids tightly closed. Lacrimation	Opacity wherever Lewisite in contact	
2–5 min.	Edema of 3rd lid beginning		Pupil strongly contracted
20 min.	Extreme edema of lids and conjunctiva		
3 hr.	Very marked swelling. Hemorrhages and dilated lymphatics all over conjunctiva		
24 hr.	Slightly less swelling	Cornea hazy and grossly edematous	Severe iritis
3 days	Eye closed with severe discharge	Severe edema	Severe iritis
10 days	Purulent discharge. Lids brawny	Cornea opaque and liquefying. No attempt at vascularization or repair	Iris not visible
3 weeks	Lids and conjunctiva contracting on to globe	Descemetocele on the point of rupture	
4 weeks	Almost complete symblepharon to disorganized globe	Phthisis bulbi	

Treatment of central corneal lesions. These lesions were used in the first group of therapeutic experiments to determine the effect on the cornea, iris, and ciliary body of treatment with BAL at varying times after contamination. Twenty-percent BAL in thiodiglycol was used in most cases, but the results were very similar for any concentration from 5 percent to 30 percent. The time series was worked out entirely with the 20-percent

Fig. 1 (Mann *et al.*). Eye of rabbit 30 minutes after contamination with liquid Lewisite. Note the extreme chemosis which largely obscures the cornea.

Fig. 2 (Mann *et al.*). Another eye (rabbit) two hours after contamination with liquid Lewisite. Note the swelling of the lids and the discharge. Chemotic conjunctiva overlaps the pupil at the inner canthus.

solution. The eyes were treated with BAL immediately, and at 1, 2, 3, 4, 5, 7, 9, 11, 13, 15, 20, 30, and 45 minutes after contamination.

The sequence of events in eyes treated immediately or 1, 2, 3 or 4 minutes after contamination was similar and as follows. (This should be compared with the sequence in the central control lesion in Table 2.) The site of application of the Lewisite became opaque immediately, and the pupil contracted strongly in two minutes, as in the control, showing that the Lewisite reached the iris and was not neutralized by the BAL entirely on the surface. After the BAL was dropped on, the central opacity became more gray and diffuse, and the epithelium in the center shed off in about six minutes. At 10 minutes, slight chemosis began, and an occasional conjunctival hemorrhage was seen. This edema then rapidly subsided, never reaching extreme proportions. An hour after the application of BAL, it had disappeared, only a little conjunctival hyperemia remaining. The site of applica-

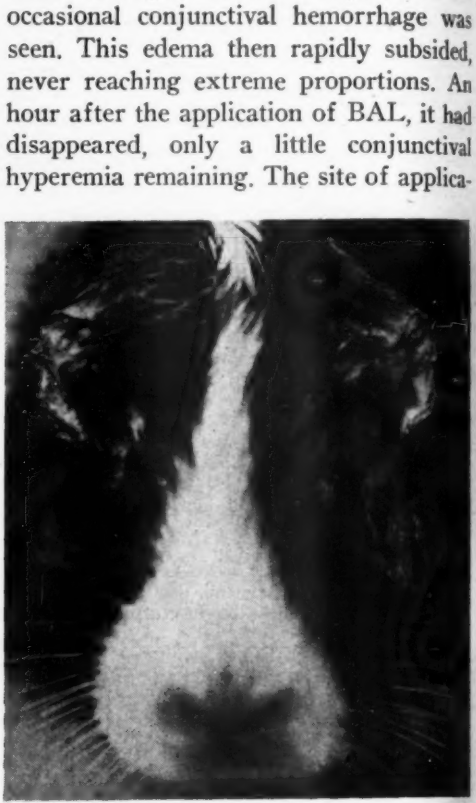

Fig. 3 (Mann *et al.*). Front view of rabbit with contamination of both eyes with liquid Lewisite 12 days previously. Note extreme swelling of lids and severe discharge.

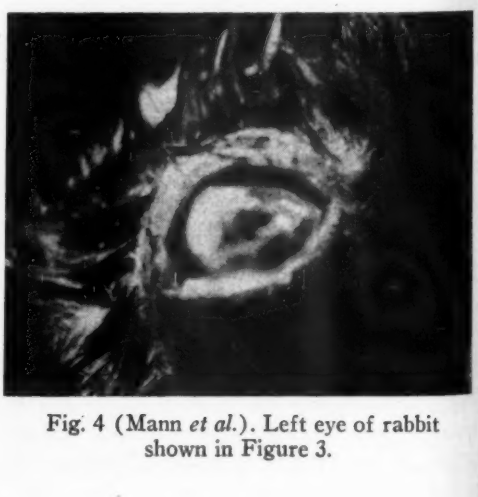

Fig. 4 (Mann *et al.*). Left eye of rabbit shown in Figure 3.

tion of the Lewisite was then localized, white, and involved the whole thickness of the cornea. The surrounding cornea was grayish. The pupil was beginning to dilate again. The eye looked irritated, the central part of the cornea was denuded, and the lesion showed as a very clear-cut opacity. The striking chemosis and swelling of the substantia propria seen in the control were absent.

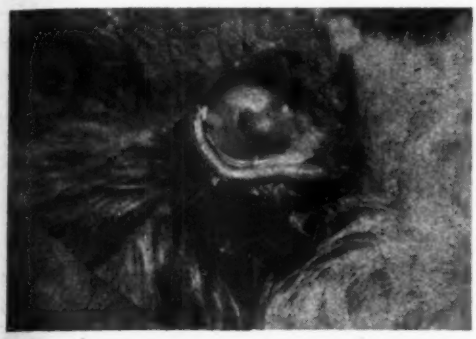

Fig. 5 (Mann *et al.*). Similar untreated Lewisite lesion in another rabbit on the 12th day.

Fig. 6 (Mann *et al.*). End result of untreated Lewisite lesion. The eye has perforated, and the lids have contracted down on it. Only a small discharging palpebral aperture is visible. 30 days after contamination.

In 24 hours, there was slight mucopurulent discharge, but the eyes were open, and the animal seemed to have little or no discomfort. The central part of the cornea stained with fluorescein and was hazy, but the limbus was normal. There was disturbance but not destruction of the

Fig. 7 (Mann *et al.*). Front view of rabbit which had received a destructive dose of liquid Lewisite in both eyes 30 days previously. The right eye was untreated, the left received immediate treatment with a drop of 20-percent BAL in thiodiglycol. The right eye has perforated; the left is normal.

Fig. 8 (Mann *et al.*). Left eye of rabbit, seen in Figure 7, two days after Lewisite contamination and immediate treatment with 20-percent BAL. Note corneal edema and slight haze and roughening. There is no iritis. The eye became perfectly normal.

Fig. 9 (Mann *et al.*). Eye of a rabbit contaminated with Lewisite 26 days previously and treated after five minutes with BAL. The eye is normal.

endothelium in the central part. No trace of iritis or intraocular response of any kind was present.

In two days, the cornea was clearer, and only a small central area stained. This was healed by the fourth day, when the eye was open, bright, and normal, except for the small, central lesion which showed as a yellowish, slightly depressed area. It resembled an ulcer, but the epithelium was intact over it. On this day, the invasion by polymorphs and macrophages described by Pullinger and Mann (1943) as a stage in the process of avascular healing of the cornea could be observed with the slitlamp. It was greater by the seventh day, when the cells could be seen surrounding and invading the central localized opacity. The whole structure of the cornea in this region, including the collagen fibrils themselves, appeared to be altered and destroyed. The barrage of invading cells gradually extended into and beneath the lesion. Long, new, silky fibrils appeared, extending into it from the margins and gradually orientating themselves in the direction of the corneal lamellae, reconstituting them. This process took some time, slowly continuing for about three weeks, during which time the eye was clear, bright, and practically normal, except for biomicroscopic changes in the central area.

By about the 25th day, the new tissue in the repaired area had pushed out a small, central, subepithelial bleb of corneal debris. This gradually seemed to liquefy until it appeared as a minute vesicle which then became absorbed without rupturing. It took almost three months to disappear to slitlamp examination but, clinically, the eye appeared normal throughout. This slow casting off and repairing of a small portion of the corneal substance was interesting to watch and seemed to indicate that, at the point of maximum concentration of the Lewisite, a minute area of irreversible destruction occurred, no matter how rapidly the BAL was applied. The end result was, however, always repair, although a very faint difference in texture of the central fibrils of the substantia propria could be detected with the slitlamp. In a few eyes, the area of repair remained slightly thinner than the rest of the cornea and appeared as a

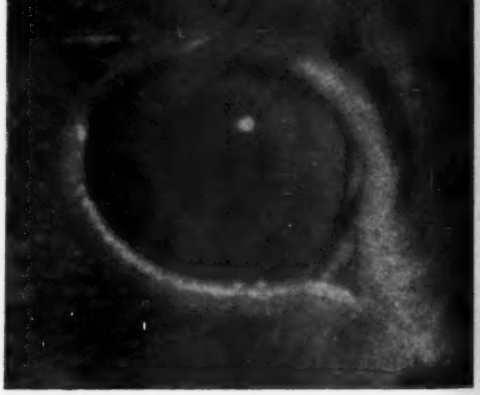

Fig. 10 (Mann *et al.*). Eye of a rabbit contaminated with liquid Lewisite 20 days previously and treated after 10 minutes with BAL. The eye is normal.

minute facet, but this often became filled and flattened out by hyperplasia of the epithelium overlying it.

If the application of BAL was delayed for five minutes, the changes observed were more severe, and the process of repair took longer, although the end result was equally good. The immediate course of events was similar to that described for 1-, 2-, 3-, and 4-minute intervals, with the exception that the mucopurulent discharge continued for three days, and the eye appeared very tender to touch until the third day. On the fourth day, the epithelium was healed, and a pigment slide was present (Mann, 1944). Edema of the substantia propria extended to the limbus all round, and the limbal vessels were engorged. They began to invade the cornea on the fifth day, as in the untreated lesion. It appears likely that the signal for corneal vascularization is always extension of edema of the substantia propria to the limbus. No vessels were ever seen invading through normal substantia propria from a normal limbus.

Fig. 11 (Mann *et al.*). Eye of a rabbit contaminated with liquid Lewisite 18 days previously and treated after 10 minutes with BAL. The result is not quite so good as that seen in Figure 10. There is still slight corneal edema and a patch of depigmentation of the iris can be seen below.

Fig. 12 (Mann *et al.*). Eye of a rabbit contaminated with liquid Lewisite 26 days previously and treated after 10 minutes with BAL. The result is good, the cornea being clear, but there is an area of depigmentation of the iris in the lower part.

Instead of extending exuberantly to the center, as in the untreated control, these vessels began to retrogress and the edema to clear on the 12th day. It was then evident from the presence of faint opacities in the aqueous that there had been a mild iritis. No synechiae were formed and no depigmentation occurred. The vessels all disappeared rapidly, and the center of the lesion healed with the formation and absorption of the small bleb described above. The end result was as good as if the BAL had been applied immediately, but the course of the healing included early, but rapidly reversed, vascularization and a very mild iritis. Similar results were obtained after delays in application of BAL for 7, 9, 11, 13, and 15 minutes, the vascularization after each longer delay in treatment becoming more severe and taking longer to retrogress. In a few cases, "BAL dots" were seen, but these were rare when BAL was used after Lewisite.

If, however, BAL was not applied for 20 to 25 minutes after Lewisite, some of the changes were irreversible, and healing occurred with the formation of vascular corneal scars, produced by the entry of fibroblasts as well as the polymorphs and macrophages. The iritis also was more

severe, and areas of depigmentation were left on the iris. The course of events in such eyes treated after 15 or 25 minutes is summarized in Table 4.

It will be seen that, in the eye described in Table 4, the record is almost the same as for the untreated eye (table 2) for the first 24 hours. A difference from the control is shown by the fact that only a mild iritis occurred at 24 hours and that the marginal vascularization, which began as in the control, retrogressed between the 7th and 12th days and finally disappeared. The treated eye at three weeks was normal, except for slight depigmentation of the iris; whereas, the control eye was vascularized to the center of the cornea and about to perforate.

It will be seen that, if BAL is applied 15 or even 25 minutes after Lewisite, there is the possibility of retaining a functional eye, although the initial period of severe damage gets longer. The time at which reversal of the change can be definitely recognized is, with these long time intervals, about 12 days, during which time the treated eye appears almost as severely damaged as the control.

If treatment is delayed for 30 minutes, the vascularization is more severe and the resulting scar larger. However, even after this long delay, the ciliary body and the rest of the eye are not seriously involved.

If treatment is delayed for 45 minutes, the course is exactly similar to that of an

TABLE 4

COURSE OF A CENTRAL CORNEAL LEWISITE LESION TREATED WITH BAL AFTER 15 MINUTES

Time	Lids and Conjunctiva	Cornea	Iris
(Application of Lewisite)			
Immediate		Central opacity	
2–5 min.	Lacrimation		Pupil strongly contracted
15 min. (Application of BAL)			
3 hr.	Severe edema of lids and conjunctiva but not so severe as control	Corneal epithelium shed. Edema of substantia propria all over	Faint aqueous flare
24 hr.	Chemosis and lid swelling better. Subconjunctival hemorrhages	Staining nearly all over with fluorescein	Aqueous flare only
3 days	Practically no discharge	Epithelium healing	Aqueous flare only
6 days	Practically no discharge	Epithelium healed. Marginal vascularization of cornea	
7–12 days	No swelling or discharge	Central opacity. Margin clearing and vessels retrogressing	Depigmentation of part of iris. Aqueous clear
3 weeks	Normal	Small central nebula and bleb only. Vessels all empty and barely detectable	No iritis

untreated eye. The eye shrinks, the lens becomes opaque, the iris and ciliary body are disorganized, and the fundus partially depigmented. Treatment must, therefore, be given in the first half hour and preferably in the first five minutes.

Treatment of splash-and-blink lesions. A somewhat similar series of results was obtained when the Lewisite was applied by the splash-and-blink technique. Since this method produces a much more severe lesion than does the central application, minor changes could be detected.

If, however, the time interval was lengthened, the results were not quite so good as in the series of central lesions. This was probably due to damage to the limbus, which by producing local edema permits vascularization. The results are shown in Table 6.

The demonstration afforded by the foregoing experiments of the value of BAL led naturally to an investigation of alternative ways of using it. Experiment-

TABLE 5

COURSE OF CENTRAL CORNEAL LEWISITE LESION TREATED WITH BAL AFTER 25 MINUTES

Time	Lids and Conjunctiva	Cornea	Iris
(Application of Lewisite) (Application of BAL after 25 min.)			
Immediate to 13 days	Almost as control	Vascularized all round on 4th day like control	Severe, but not so severe as control
18 days	Very little discharge	Margin of cornea clearing and vessels less exuberant	Iris depigmented
27 days	Very little discharge	Most vessels gone but a few large ones enter dense central opacity	
6 weeks	No discharge	Central vascular scar with some degenerative change. Eye not blind	Permanent depigmentation

the course of healing was not expected to be so striking. It was, however, found that immediate application of BAL to such a lesion produced an even better result than with a central corneal lesion. This is explained by the fact that the Lewisite is instantly spread all over the eye by the lids and, therefore, does not penetrate anywhere so deeply before the BAL can reach it. There was no central area of destruction to be cast off and repaired. A small area of superficial destruction of the substantia propria was present, but this was quickly repaired. Clinically, the eye looked normal in two days and even with the slitlamp only

ally, it is easy to separate a rabbit's eyelids and insert a drop of BAL. Under war conditions, however, a man might have difficulty in overcoming the intense lid spasm produced by Lewisite either in administering first aid to another person, or in attempting to treat himself.

The question of method, therefore, seemed important and, as described, experiments were done using drops of 2-percent, 10-percent, 20-percent, and 30-percent BAL in thiodiglycol. The results for 10 percent and 20 percent were the same. It was then decided to try the effect of merely rubbing the solution on to the outside of the lids, without forcing

the eye open. The rabbit's lids were shaved, and the liquid was massaged into them with a glass rod. It was found that, if the liquid was applied to the skin of the lids, carefully avoiding the lid margin, no protection was afforded at all, and the eye lesion ran its destructive course. If, however, the liquid came in contact with the lid margin, a sufficient quantity seeped into the eye to act on the Lewisite rapidly and to avert destruction of the eye. It also relaxed the lid spasm and made it easy to insert more BAL into the eye. Massage of BAL on to the lid margin, therefore, seemed the method of choice for man.

It was found that, if a 10-percent solution was massaged in, the amount of BAL which actually entered the eye was not always sufficient to reverse the Lewisite action. Application of BAL up to five minutes after contamination of the eye with Lewisite gave excellent results, but application between five and ten minutes after contamination with Lewisite was not so successful. Two out of 10 eyes perforated and were lost, and the rest healed with vascular scars, a worse result than would have been obtained if 10-percent BAL had been dropped into the eye.

If, however, 20-percent BAL was applied to the lid margin up to 10 minutes after contamination, the results were excellent and were good after 15 minutes' delay. This strength was, therefore, used.

Since a solution of BAL might be difficult to carry about and to manipulate, experiments were tried incorporating the BAL in various ointment bases which were known to be nonirritating to a normal eye. It was found that the results of massaging 20-percent BAL ointment into the margins of the closed lids gave, on the whole, good results, although, in a few cases, insufficient BAL reached the eye to save it.

TABLE 6

APPLICATION OF BAL TO A SPLASH-AND-BLINK LEWISITE* LESION

Time	Result
Application of BAL	
Immediate	Very good indeed
5 minute-interval	Very good, but vascularization of cornea and slight depigmentation of iris
10 minute interval	Good result with clear cornea and depigmented iris
15 minute interval	Good result with lightly vascularized peripheral scar slow in healing
20 to 25 minute interval	Result more problematic. Some healed with vascular scars after iritis; some eyes were useless

* If slightly less than the destructive dose of Lewisite was used, the results were excellent up to 25 minutes.

Twenty experiments were done giving the results found in Table 7. It is obvious that good results can be obtained by massaging BAL ointment into the margins of the closed lids, but these results are not so good as those given by opening the eye and dropping a 20-percent solution directly on to the cornea. If this is done, no eye is completely destroyed until the time interval is more than 30 minutes.

4. EFFECT OF BAL ON EYES INJURED BY OTHER ARSENICALS

BAL was used in a short series of experiments as an antidote to methyl- and ethyldichlorarsine. The effect of methyl-

and ethyldichlorarsine on the eye is similar to that of Lewisite, itself, given in a comparable dose. The eye is rendered useless both when the liquids are applied to the center of the cornea, or by the splash-and-blink method.

The effect is not quite so violent as that of Lewisite. Only one out of five control eyes ended in perforation of the cornea; the others were blinded by shrinking of the whole eyeball or by the formation of dense vascular scars and gross destructive lesions of the intraocular structures. No difference in action could be detected between the methyl and ethyl compounds.

Treatment was carried out by dropping a 20-percent solution of BAL in thiodiglycol into the eye immediately and after intervals of 5, 10, 15, 20, and 25 minutes. Twelve eyes were used (two contaminated with methyl- and 10 with ethyldichlorarsine). In all but three, the application was by the splash-and-blink technique. The results obtained were similar to those obtained with Lewisite, with the exception that "BAL dots" were more readily detected in the healed eyes than they were in the Lewisite series. Immediate application saved the eye completely. Application of BAL up to 25 minutes after contamination also saved the eye in every case. In several eyes, however, small vascular scars and patches of depigmentation of the iris remained. On the whole, the results were slightly better than in the Lewisite series.

5. Effect of BAL on eyes injured by a mixture of Lewisite and dichlorodiethyl sulphide (mustard gas)

It had been suggested that use in war of a mixture of equal parts of Lewisite and mustard gas was a possibility. From an offensive point of view, it was difficult to see what would have been gained by mixing a rapidly destructive and almost instantly detectable chemical-warfare agent with one whose chief advantages were slowness of action and absence of immediate warning effects. It was, however, decided to investigate the action of BAL against such a mixture in the eye. We know already that BAL exercises no curative action on the lesion caused by mustard gas alone. It does not make it worse, and any action it may have is a purely mechanical one and not specific in any way.

We did not know either the effect on the eye of mixing Lewisite and liquid mustard gas, nor whether BAL would exercise any effect on the mixture. Eight experiments only were done. The results were very clear cut and in accordance with what we know of the action of Lewisite and of mustard gas on the eye and of the effect of BAL. They can be briefly described.

If a 50:50 mixture of Lewisite and

TABLE 7

Results of Massaging BAL ointment into margins of closed lids

Time Interval	No. of Eyes	Result		
		Very Good	Fair	Eye Lost
		(Clear cornea or only a few vessels)	(Vascular scar)	
Up to 5 min.	12	8	2	2
10 min.	8	3	2	3

mustard gas is applied to a rabbit's eye in the manner described for Lewisite (central corneal lesion and splash-and-blink lesion), the course of events is exactly that which would have been expected from Lewisite alone. The eye is destroyed in the same time and by the same process. Since in the case of lesions with mustard gas alone, we knew that the course of a central corneal lesion is not the same as that of one involving the limbus (Mann and Pullinger 1940, 1942, 1942, and Mann 1942), we also tried the effect of an untreated limbal lesion made with the mustard-gas-Lewisite mixture. Its course was again that of a pure Lewisite lesion.

We, therefore, tried the effect of immediate treatment with 20-percent BAL of a central-corneal lesion produced with 50:50 Lewisite-mustard gas. The eye recovered without iritis or vascularization and also without extrusion of corneal debris. The result was better than if Lewisite alone had been used. This is explicable by the fact that, in a standard droplet of the mixture, there was less Lewisite than was used in the first group of experiments described above (in which a very small portion of the corneal substance was destroyed before the BAL could act). The central nebula resembled the "silky" result of a central, non-vascularizing mustard-gas lesion and disappeared entirely.

If the same dose of the mixture was applied as a droplet astride the limbus and treated immediately with BAL, the result was very interesting. The prophylactic effect on the Lewisite moiety was complete. No Lewisite iritis, vascularization, or separation of debris occurred. Healing, however, was delayed as the lesion ran the typical course of a small, untreated limbal mustard-gas lesion. On the fourth day, a secondary edema involved most of the cornea and small blood vessels, preceded by intracorneal hemorrhages and showing pointed ends, invaded the limbus on either side of the lesion and elsewhere where the edema reached the limbus. These vessels were deep and of a shape and arrangement known to be typical of vascularization following mustard-gas burns. They remained mildly active for about eight weeks, and the eye finally healed with only a few traces of empty vessels. This shows a very neat "sorting out" and neutralization of the Lewisite molecules by the BAL; the mustard-gas action being unaffected.

Treatment by Bal was also given to splash-and-blink lesions with the Lewisite-mustard-gas mixture. The immediate application prevented all Lewisite effect, but slight edema from the mustard gas was visible at the lower limbus, and a few deep vessels invaded here on the sixth day. These disappeared in four weeks.

If treatment of such a splash-and-blink lesion was delayed for 15 minutes (or even 5 minutes), a good deal of vascularization occurred. The vessels were numerous and arranged in straight rows like those typical of Lewisite, but they were larger than these usually are and accompanied by a few intracorneal hemorrhages which we have come to look on as very suggestive of mustard-gas burns. The eyes cleared in about six weeks, leaving faint, vascular nebulae. There appeared to be a mixed effect here, the Lewisite change having begun before the BAL could act.

It is obvious that BAL should be used in treatment of a mixed contamination and as speedily as possible.

Summary and Conclusions

1. The action of 2:3 dimercaptopropanol (BAL) was studied on the intact rabbit's eye, on eyes contaminated with droplets of Lewisite, methyl- and ethyl

dichlorarsine and with a mixture of Lewisite and liquid mustard gas.

2. A single application of BAL in solutions of 1 percent to 30 percent in thiodiglycol to the intact rabbit's eye was without permanent ill effects. Application of pure BAL was slightly more irritating but the eyes recovered from this also. BAL was, therefore, a possible therapeutic substance for eye lesions.

3. Application of BAL within five minutes to an eye contaminated with a destructive dose of Lewisite was successful in preventing the action of the Lewisite. Applications delayed for varying times up to 25 minutes also saved the function of the eye, although partial permanent damage remained.

4. A 20-percent solution of BAL in thiodiglycol gave the best results when dropped into the eye. Surprisingly good results were, however, obtained with 20-percent ointments rubbed onto the closed lids along the line of the palpebral aperture.

5. BAL is equally effective as an antidote to methyl- and ethyldichlorarsine.

6. BAL is effective against the Lewisite moiety of a Lewisite: mustard-gas mixture, but the lesion due to the mustard-gas portion progresses uninfluenced.

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TESTS FOR HETEROPHORIA*

Reliability of tests, comparisons between tests, and effect of changing testing conditions

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Muscle balance is a subject in which the student of ocular functions almost invariably takes an early interest. The discovery of several points soon lessens this interest. Among these is the clinical observation that relatively large amounts of heterophoria may be present in an individual and yet that individual may be perfectly comfortable. Another of these is the statement found in the literature on ocular muscle balance that heterophoria varies not only from day to day but also from moment to moment in the same individual.[1,2] These two observations lead many students to the conclusion that it matters little what test of heterophoria is used or how carefully it is performed since the results will probably be inaccurate and of dubious significance.

Nevertheless, in any thorough survey of ocular functions, heterophoria cannot be neglected. Heterophoria is a deviation of the eyes from the position of fixation when fusion is prevented.[2] Measurements of heterophoria, therefore, reveal how much of a motor task fusion has to perform in bringing images upon corresponding retinal points. Certainly the individual with little or no heterophoria, all other things being equal, will secure binocular single vision with much less effort than the individual with marked heterophoria. The average clinician is not particularly concerned with whether his patient has 4 prism diopters of exophoria or 6 prism diopters of exophoria, unless that exophoria is indicative of symptom-producing strain. Neither is he particularly concerned when a patient tested on one day shows 4 prism diopters of exophoria and when tested again, on a subsequent visit, shows 6 prism diopters of exophoria.

When it becomes necessary, however, to select large numbers of men in accordance with certain arbitrary standards of heterophoria, as in the selection of pilots for the Army Air Forces, the amount of the heterophoria and the reproducibility of the determinations become important. To illustrate the point, the exophoria limit for pilots for Class 1 in the Army Air Forces has been chosen as 5 prism diopters. An applicant for pilot training who has more than this amount will receive no further consideration. If, after attaining his coveted "wings," a pilot is found to manifest more than the limit of 5 prism diopters of exophoria at any time, he will be "grounded," perhaps for a time, perhaps permanently.

At least three sources of error may be recognized in the routine performance of tests now available. First, an individual may have inconstant amounts of manifest heterophoria.[3] This variation may be due either to a variation in the amount of

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manifest heterophoria of the subject or to inaccuracies in the testing technique. The two sources of variation are inseparable and may be considered together as individual variation. In evaluating tests for heterophoria, those which show little individual variation in comparison with the total range in the sample of tested subjects will be preferred over those which show large individual variation. This is the same as saying that the test must have high reproducibility or *reliability.*

Second, examiners may not all perform the test for heterophoria in exactly the same way. Particularly if a large number of individuals must be examined at many different places in short periods of time, as in time of war, the multitude of examiners will not have equal degrees of competence in the administration of the test.

Third, different tests or conditions of testing may not be equally effective in converting similar amounts of the total heterophoria into manifest heterophoria which can be measured. Despite the number of tests available, a comparison of the tests by modern statistical methods has seldom been made. Cridland's work[4] stands almost alone in this field.

The present study is directed toward answering some of the questions about the available tests for heterophoria. First, we shall estimate the reliability of the screen Maddox-rod test, and in the same experiment look for systematic differences between examiners which may contribute to unreliability. The screen Maddox-rod test was chosen because this test, described by Dolman,[5] has been in use throughout the Army Air Forces. Second, we shall make comparisons between several available tests, including among these the screen and parallax test which is universally regarded as being the most accurate one. These comparisons were made at two different testing distances, 20 feet for distance fixation and 13 inches for near fixation. Third, we shall attempt to estimate the effect of varying the testing conditions upon the Maddox-rod test. The alternative conditions studied were a light vs. a dark room, the use of screening vs. not screening, the placing of the Maddox rod over the dominant vs. the nondominant eye, and the use of a red vs. a white Maddox rod.

Description of tests

All of the tests used in this study are familiar to students of ocular muscle balance. With one exception, only brief descriptions will be given.

Screen and parallax test. A 1-cm. light was used at 20 feet and an ophthalmoscope with the head removed was used at 13 inches. A cover was shifted from one eye to the other, square prisms being changed behind the cover until any objective movement of the eye and any subjective movement of the light had ceased.

von Graefe's prism diplopia test. At a distance of 20 feet, a 20/100 size Snellen letter "E" was employed as a test object, while at 13 inches a similar letter "E" 2 mm. in height was used. The test object was adequately illuminated at both distances and an insuperable diplopia was created with a vertically placed 5-diopter prism before one eye. The examinee was asked to adjust the two images (by means of a Risley rotary prism) so that they were in the same vertical line.

Screen Maddox-rod test. Because the study to be reported concerns the technique of the screen Maddox-rod test, the test is described in full. At 20 feet, the test object was a muscle light, 1 cm. in diameter; at 13 inches, it was an ophthalmoscope with the head removed. All lights in the immediate vicinity of the muscle light were turned out but the room was not entirely darkened. With the Maddox

rod placed before the nondominant eye, a cover was also held before the same eye and removed regularly for a period of 1 second at about 3-second intervals, meanwhile allowing the dominant eye to maintain fixation constantly. This very brief uncovering or "flashing" of the nondominant eye had for its purpose a further weakening of the fusion control. For the measurement of heterophoria, a Risley rotary prism is rotated into position (also before the nondominant eye) and set between 3 and 4 diopters "off" of the zero position; this forces the examinee to make some adjustment even though orthophoria is present. The examinee grasps the handle of the rotary prism and, while the muscle light is being "flashed" before the eye behind the Maddox rod, he is instructed to adjust the line so that it bisects the light.

Maddox-rod test. This test is the same as the screen Maddox-rod test just described except that screening is omitted.

Maddox-wing test. Used at 13 inches, this is a well-known test and needs no particular elaboration other than to mention that an arrow is seen by the right eye only, while calibrated lateral and vertical scales are seen by the left eye only.

Thorington test. This is also a well-known test and employs a Maddox rod. Linear scales, calibrated in units of 2 prism diopters, are drawn on the face of a card which is mounted on the head of a flashlight, a pin hole being located at the exact center of the card which is also the point of intersection of the lateral and vertical scales. The flashlight bulb is visible only through the hole in the card's center. The testing distance is 13 inches. A Maddox rod is placed before one of the examinee's eyes and he is asked to state at what point the line of light (as seen through the Maddox rod) intersects the calibrated scales.

Reliability of the screen Maddox-rod test

The problem of reliability of the screen Maddox-rod test was approached from the point of view that if the test were not reproducible under relatively ideal conditions, then it was not likely to be reproducible under the routine testing conditions necessary for the physical examination for flying used in the Army Air Forces. The experiment was therefore planned to yield a maximum reliability of the screen Maddox-rod test.

Plan of study. Two examiners, who had watched each other work and whose testing techniques were as nearly identical as possible, performed the tests. Both examiners tested each subject on each of two different days. No subject remained seated in the examination room for consecutive tests by both examiners; instead, one examiner examined the entire group of subjects for the day before turning them over to the second examiner. The test-retest interval varied from 1 to 5 days. Both lateral and vertical heterophoria measurements were made at each testing period. All subjects were tested at the 20-foot distance; none wore glasses and there was no correction of refractive error. The screen Maddox-rod test technique as outlined in the previous section was utilized throughout.

Limitations of the study. All subjects were aviation cadets who, theoretically, had a visual acuity of at least 20/20 in each eye, a normal amount of accommodation and convergence, and heterophoria of not more than 1 prism diopter of hyperphoria, 10 prism diopters of esophoria, or 5 prism diopters of exophoria. The population available for study therefore represented a special selection from the general population with the consequence that the heterophoria readings extend over a limited portion of the entire range.

Another limitation arose from the fre-

quency distribution of heterophoria which was not normal in form. A distribution for 131 subjects tails out to the right (the statistic of skewness, $g_1 = 1.38$, is 6.5 times its own standard error; the statistic of kurtosis, $g_2 = 4.37$, is 10.4 times its own standard error). To test the normality of distributions still further, data were borrowed from Cridland[4] for the purpose. In one of these (the red-green test) there is significant skewness to the right and in the other (the Maddox-rod test) there is significant skewness to the left. The inconsistency of these findings suggests no general way of transforming the heterophoria scale to normality at this time.

Results. The results of testing 50 subjects for lateral heterophoria and 49 subjects for vertical heterophoria are summarized in Table 1. Examiner A recorded an average of 1.10 prism diopters of esophoria and Examiner B, an average of 1.30. This difference is not significant ($F = 3.92$ where $F_{.01} = 6.90$) and consequently there is no evidence of general disagreement between examiners. Furthermore the examiners agreed within the limits of experimental error for all subjects. (The interaction S × E is not significant.) Similar statements may be made with respect to the records of vertical heterophoria. Under the relatively ideal conditions of this study, therefore, it was found possible to achieve a high agreement between examiners, and the results are similar to those which may be expected if a single examiner performed all the testing.

The measurements of both lateral and vertical heterophoria are highly reliable when made with the screen Maddox-rod test. The coefficients of reliability are +0.95 and +0.92 for the two types of measurements, respectively. These coefficients are based upon the internal consistency of the four records taken on each subject and are computed by a method suggested by Hoyt.[6] In practical terms, these coefficients mean that any careful examiner can make heterophoria measurements with sufficient accuracy to discriminate between subjects. A notion of the absolute accuracy with which heterophoria may be measured may be obtained

TABLE 1

AVERAGE HETEROPHORIAS OBTAINED BY TWO EXAMINERS USING THE SCREEN MADDOX-ROD TEST, ANALYSIS OF VARIANCE APPLIED TO MEAN DIFFERENCES, AND RELIABILITY COEFFICIENTS

Examiner	Lateral, n = 50			Vertical, n = 49		
	1st Test	2nd Test	Average	1st Test	2nd Test	Average
A	+1.02	+1.18	+1.10	−0.06	−0.11	−0.09
B	+1.39	+1.22	+1.30	−0.10	−0.08	−0.09
			+1.20			−0.09

Variation Due to	df.	Mean Square	F	df.	Mean Square	F	$F_{.01}$
Subjects, S	49	11.27	21.03	48	0.43	12.56	1.73
Examiner, E	1	2.10	3.92	1	0.001	—	6.90
S×E	49	0.24	—	48	0.04	1.12	1.73
Error	100	0.54		98	0.03		
Standard error of a single determination		0.73			0.18		
Coefficient of reliability		+0.95			+0.92		

Note: For lateral heterophoria, + means esophoria, − means exophoria; for vertical heterophoria, + means right hyperphoria, − means left hyperphoria.

from the standard errors of single determinations. For lateral heterophoria, the standard error is 0.73 which means, approximately, that a lateral heterophoria measurement may be in error by as much as 1.5 prism diopters (2×0.73). For vertical heterophoria, the error may be as much as 0.4 prism diopters (2×0.18).

Comparisons between tests

Many factors, both anatomic and innervational, determine the amount of heterophoria elicited by any one test at any one time. If it were possible to eliminate entirely all these innervational factors, then the eyes would assume the position variously referred to as the position of rest, the fusion-free position, or the fusion-frustrated position. Bielschowsky[1] has pointed out that any determination of the absolute position of rest is practically impossible because the totality of nervous influences cannot be eliminated in any way.

Various tests of heterophoria yield varying results in the same individual because varying numbers of innervational factors are eliminated by each of the different tests. In choosing a heterophoria test for use in testing large numbers of men, as in time of war, it is necessary to have an accurate test that can be administered in a minimum of time. Of all heterophoria tests, the screen and parallax test eliminates a greater number of innervational factors than any other test and thus allows the closest possible approach to the position of absolute rest. The screen and parallax test is considered somewhat tedious by the novice, however, and requires a fair degree of skill for proper performance. Hence it appears desirable to know how other tests of heterophoria compare with the screen and parallax test.

TABLE 2

AVERAGE LATERAL HETEROPHORIAS, STANDARD DEVIATIONS, AND COEFFICIENTS OF CORRELATION BETWEEN TESTS FOR HETEROPHORIA

	20 Feet			13 Inches				
	Screen and parallax	Screen Maddox rod	von Graefe prism diplopia	Screen and parallax	Screen Maddox rod	von Graefe prism diplopia	Maddox wing	Thorington
Mean $\bar{x}$	+0.5	+1.4	+1.8	−8.2	−5.9	−3.0	−3.0	−2.8
Stan. Dev. s_x	2.2	2.8	1.9	7.4	5.8	5.2	3.4	4.3
Correlation coefficients, r								
Screen Maddox rod	+0.81	—	—	+0.48	—	—	—	—
von Graefe prism diplopia	+0.84	+0.85	—	+0.72	+0.41	—	—	—
Maddox wing				+0.68	+0.29	+0.76	—	—
Thorington				+0.77	+0.35	+0.88	+0.70	—

Note: For lateral heterophoria, + means esophoria, − means exophoria. To be significant, any r should exceed $r_{0.01} = +0.36$.

Plan of Study. Fifty aviation cadets were tested by a single examiner for lateral heterophoria on eight tests, three with a testing distance of 20 feet, and five with a testing distance of 13 inches. At 20 feet, the screen and parallax test, von Graefe's prism diplopia test, and the screen Maddox-rod test were used. At 13 inches, the screen and parallax test, von Graefe's prism diplopia test, the Maddox-wing test, the Thorington test, and the screen Maddox-rod test were used.

Results. It is obvious from the sum-

mary of results in Table 2 that the tests which use a testing distance of 20 feet do not agree precisely with each other. Yet the level of agreement is reasonably high considering the diverse nature of the tests. All three tests yielded about the same average heterophoria and about the same spread around the averages. The coefficients of correlation are equal within the limits of random sampling. There is no clear choice among these three tests based upon statistical evidence alone. From the standpoint of ease of performance and time required, the screen Maddox-rod test may be preferred by some to either von Graefe's prism diplopia test or the screen and parallax test.

When the heterophoria tests which use a testing distance of 13 inches are considered, the screen Maddox-rod test is apparently no longer the satisfactory test that it was at 20 feet (table 2).

The screen and parallax test, as expected, uncovered the highest average exophoria, 8.2 prism diopters. The screen Maddox-rod test uncovered an average of 5.9 prism diopters of exophoria. The other three tests were about equivalent. They uncovered an average of 3.0 prism diopters of exophoria in the sample of 50 subjects. The variabilities about the averages, as judged by the standard deviations, are quite different. Consequently, on the basis of the means and standard deviations alone, the five tests at 13 inches cannot be regarded as equivalent. The coefficients of correlation reveal that four of the tests would rank the subjects in approximately the same order of degree of heterophoria. The exception is the screen Maddox-rod test which is not sufficiently correlated with the other four tests to be used as a replacement for any one of those tests. The coefficient of correlation of the Thorington test with the screen and parallax test is 0.77, while that of von Graefe's prism diplopia test is 0.72, and that of the Maddox-wing test is 0.68. The screen Maddox-rod test trails all the others with a correlation coefficient of only 0.48.

Although the screen Maddox-rod test is apparently in a class by itself at a testing distance of 13 inches, this may in part be due to the fact that the sample is preselected on the basis of the screen Maddox-rod test. Removal of this restriction might yield a higher correlation with the screen and parallax test. However, in another sample of similar subjects tested in similar fashion, the screen Maddox-rod test agreed well with the screen and parallax test. This sample is discussed in a later section.

It must be realized that the screen Maddox-rod test at 13 inches, although apparently in a class by itself, may possibly be the best instead of the worst test of heterophoria and that it may be measuring something that the other tests are not. It is unfortunate that the present state of our knowledge is insufficient to allow a decision to be made.

Conditions of the Maddox-rod test

The screen Maddox-rod test has been found to have a satisfactory self-consistency, at least under ideal conditions, and a satisfactory agreement with the screen and parallax test when the testing distance is 20 feet. These facts, plus its relative ease of administration, make it a desirable test for use for routine measurements of heterophoria on large numbers of subjects, as in time of war.

The screen Maddox-rod test was chosen as the standard test for the Physical Examination for Flying (WD AGO FORM No. 64). Certain variations in the testing conditions appeared during the war, and their effect upon the heterophoria measurements was not known, at least not in quantitative terms. Among the departures from uniform conditions, the following alternatives were regarded as important

enough to merit special study: a light vs. a dark room, the use of screening vs. not screening, the placing of the rod over the dominant vs. the nondominant eye, and the use of a red vs. a white Maddox rod.

The effect of illumination in the testing room was investigated in a separate experiment. The other three alternatives were incorporated into a single experiment.

Effect of illumination

There are conflicting arguments in the literature on heterophoria about the amount of illumination required or permitted in the testing room. Those who prefer testing in darkness contend that, if only a spot of light is visible in an otherwise dark room, any planes of reference which would serve to fix accommodation will be lost in the darkness and therefore eliminated as variables. More heterophoria would be uncovered in this manner and hence the test made more accurate. The assumption behind this argument is, of course, that the test uncovering the most heterophoria is the best.

In contrast, those who prefer testing in an illuminated room maintain that the subject in darkness is in an abnormal situation in no way comparable to conditions requiring visual efficiency which might reasonably be affected by heterophoria.[4]

Methods

In an experiment designed to resolve this difference of opinion, lateral and vertical heterophoria was determined under two alternative conditions at a testing distance of 20 feet upon 60 subjects. All the subjects were aviation cadets and thus were a selected group. The two conditions of testing were:

1. Dark. The testing room was in complete darkness except for a muscle light 1 cm. in diameter located 20 feet from the subject. The walls and ceiling of the room were painted black.

2. Light. The same room was used except that a 60-watt, frosted Mazda bulb was burning directly above the subject's head. Illumination measured 5 foot-candles at head-height directly beneath the bulb (9-foot ceiling) and 0.5 foot-candles at the end of the room (20 feet away) where the muscle light was located. In this illumination, all objects in the room could be seen fairly distinctly.

There was no appreciable lapse of time between tests, the light-room and dark-room determinations being made at the

TABLE 3

Comparison of heterophorias determined in light and in dark

	Lateral		Vertical	
	Light	Dark	Light	Dark
Mean, $\bar{x}$	+1.17	+1.02	−0.03	−0.02
σ	2.20	2.37	0.24	0.25
Correlation, r	+0.89		+0.90	
Mean difference	0.150		−0.008	
Standard error of mean difference	+0.137		+0.015	
Ratio, t*	1.10		0.55	

n = 60 subjects.
* For the mean difference to be significant, t should exceed 2.66.
For lateral heterophoria, + means esophoria, − means exophoria; for vertical heterophoria, +means right hyperphoria, − means left hyperphoria.

same examination on each subject, although the order of the two tests was reversed in every other subject.

Results

The results of the tests for heterophoria using the screen Maddox-rod test under the two conditions of illumination are summarized in Table 3. For this group of 60 subjects, the following assertions may be made:

1. The average heterophorias, determined in light and in dark, are not significantly different. This is true for both lateral and vertical heterophoria.

2. The variability about the average, measured in terms of the standard deviation, is essentially the same for the two conditions of illumination, for both lateral and vertical heterophoria.

3. There is a high correlation between the determinations of heterophoria in light and in dark for both lateral and vertical heterophoria.

There is no evidence, therefore, from this experiment to support the claim that amounts of illumination up to that used in this study will significantly affect the measurement of heterophoria. Cridland[4] reached a similar conclusion using the Maddox-rod test (without screening).

Effect of screening, eye dominance, and rod color

Methods

One hundred subjects, all aviation cadets, were tested for heterophoria for near and distance fixation in a refracting alley 20 feet in length whose walls were painted black. The room was illuminated as described in the previous section on Maddox-rod determinations in a "light" room. The muscle light used at the 20-foot distance was a spot of light 1 cm. in diameter. At the 13-inch distance, the light was an ophthalmoscope with the head removed. Each subject was seated comfortably in a chair and determination of the dominant eye made by asking the

TABLE 4

Average heterophorias at 20 feet and at 13 inches

	20 Feet			13 Inches		
	With Screening	Without Screening	Average	With Screening	Without Screening	Average
Dominant eye	(1)	(2)		(1)	(2)	
Red rod	+1.80	+1.49	+1.65	−4.97	−5.33	−5.15
White rod	(3) +1.58	(4) +1.11	+1.35	(3) −4.44	(4) −5.33	−4.89
Average	+1.69	+1.30	+1.50	−4.71	−5.33	−5.02
Nondominant eye	(5)	(6)		(5)	(6)	
Red rod	+1.89	+1.55	+1.72	−4.99	−5.04	−5.02
White rod	(7) +1.70	(8) +1.33	+1.52	(7) −4.70	(8) −4.99	−4.85
Average	+1.80	+1.44	+1.62	−4.85	−5.02	−4.92
Average						
Red rod	+1.85	+1.52	+1.68	−4.98	−5.19	−5.08
White rod	+1.64	+1.22	+1.43	−4.57	−5.16	−4.87
Average	+1.74	+1.37	+1.56	−4.78	−5.17	−4.98

n = 100 subjects. + means esophoria. − means exophoria.

subject to sight the muscle light across the room through a 1-cm. hole in a 10- by 10-inch board which was held at arms' length with both hands, both eyes being held open. Heterophoria measurements were first made by the method of screen and parallax using the testing distances of 20 feet and 13 inches and employing a Beren's, plastic prism bar. The calibrations on the bar had been checked and found to be correct at a previous time.

whereas, the average at 13 inches was about 5.0 prism diopters of exophoria (table 4). The variation about the averages of the determinations at 20 feet is quite unlike that of the determinations at 13 inches (table 5). These facts make it necessary to preserve a separation of the data collected at the two different distances, and to look for the effects of screening, the dominance of the eye, and the colors of the rod separately in the two

TABLE 5

STANDARD DEVIATIONS OF HETEROPHORIA DISTRIBUTIONS AT 20 FEET AND AT 13 INCHES

	20 Feet		13 Inches	
	With Screening	Without Screening	With Screening	Without Screening
Dominant eye	(1)	(2)	(1)	(2)
Red rod	2.65	2.67	5.29	5.52
	(3)	(4)	(3)	(4)
White rod	2.67	2.40	5.24	5.53
Nondominant eye	(5)	(6)	(5)	(6)
Red rod	2.98	3.07	5.66	6.07
	(7)	(8)	(7)	(8)
White rod	2.90	2.38	5.75	5.78

n = 100 subjects.
Test for homogeneity of variances:
$X^2 = 12.15$ $X^2 = 2.79$
$P = 0.10-0.05$ $P = 0.95-0.90$

After this measurement, a phorometer was accurately adjusted before the subject and testing was begun with the Maddox rod. Both red and white Maddox rods were used in testing before each eye separately, with and without the use of screening. This was done at testing distances of both 20 feet and 13 inches. All possible combinations of the four variables just mentioned were tested on each subject. This necessitated 16 separate measurements on each subject, the measurements being taken in random order.

The heterophorias determined at 20 feet are different from the heterophorias determined at 13 inches in several respects. In the present series of determinations upon 100 subjects, the average at 20 feet was about 1.5 prism diopters of esophoria; bodies of data. Further, the variabilities in the eight distributions of heterophoria for the eight experimental conditions with a testing distance of 20 feet were found to be homogeneous when tested by the method of Bartlett.[7] It appears, therefore, that whatever change is introduced into the heterophoria determination at 20 feet by a change in the experimental conditions, the change affects the average only and does not affect the distribution about the average. A similar assertion may be made for the changes introduced in the 13-inch test.

Screening vs. not screening at 20 feet. When a Maddox rod is used in heterophoria determinations, it is placed before one of the examinee's eyes. The eye behind the rod perceives a spot of light as a

line of light while the other eye sees the spot as it really is. This distortion of dissimilarity of images disrupts fusion to a certain extent, thus allowing the eye behind the rod to deviate toward its dissociated position. The extent of this deviation may be measured exactly by the utilization of prisms. Dissimilarity between the two images of the same object as perceived by the two eyes does *not* completely abolish the fusion impulse.[1, 8]

The cover test, that is, alternate occlusion of each eye separately, breaks up fusion as completely as is possible without actually occluding both eyes simultaneously. The covering or screening principle is the basis of the screen and parallax test.

The addition of intermittent screening of the eye behind the Maddox rod in testing heterophoria allows this test to approximate more closely the screen and parallax test, since the same basic principle is common to both. Omission of screening from the screen Maddox-rod test would seem to alter the test.

When the screen was used at 20 feet, the average heterophoria was found to be 1.74 prism diopters of esophoria; when the screen was not used, the average was 1.37 prism diopters of esophoria. The difference of 0.37 prism diopters is statistically significant, and indicates that on the average the use of the screen adds about 0.3 or 0.4 prism diopters to the heterophoria reading.

This difference due to screening appears to exist regardless of the color of the Maddox rod or of the dominance of the eye. When a red rod was used, the average was 1.85 prism diopters of esophoria with screening and 1.52 prism diopters of esophoria without screening, giving a difference of 0.33 prism diopters. When a white rod was used, the averages were 1.64 and 1.22 prism diopters of esophoria with and without screening, respectively, giving a difference of 0.42 prism diopters. With the rod before the dominant eye, the difference was 0.39 prism diopters (1.69 with screening minus 1.30 without screening), and before the nondominant eye, the difference was 0.36 prism diopters (1.80 minus 1.44). Table 4 contains a summary of the means for all combinations of the experimental conditions.

Screening vs. not screening at 13 inches. At 13 inches, effects comparable to those at 20 feet were found. With screening, the average heterophoria was 4.78 prism diopters of exophoria; whereas, without screening, the average was 5.17 prism diopters of exophoria, or an increase of 0.39 prism diopters. This difference is statistically significant, and is the same in magnitude and direction as the shift observed at 20 feet when screening was omitted. (An increase in exophoria is the same in direction as a decrease in esophoria.)

The effect of screening is present with the rod before either the dominant or the nondominant eye, and with both colors of rods. When the rod is before the dominant eye, the change is 0.62 prism diopters; that is, from 4.71 with screening to 5.33 without screening; and when the rod is before the nondominant eye, the change is 0.17 prism diopters; that is, from 4.85 to 5.02. With the red and white rods, the changes are 0.21 and 0.59 prism diopters respectively (table 4).

It is necessary to specify, therefore, that screening be done or omitted throughout the routine testing of heterophoria, whether at 20 feet or at 13 inches.

Dominant vs. nondominant eye at 20 feet. The question of whether the Maddox rod should be placed before the dominant or the nondominant eye during heterophoria testing is one of long standing. Dolman[5] suggested placing the rod before the nondominant eye on the basis of observations of 100 cases, 81 percent of

which revealed different heterophoria measurements when each eye was tested separately. He observed that 66 percent exhibited more heterophoria when the rod was placed before the nondominant eye; 7 percent had more with the rod before the dominant eye; and 17 percent gave identical figures regardless of which eye was behind the Maddox rod. Dolman made conflicting interpretations of these observations when he said ". . . it is evident . . . that the unequal degrees of deviation depend upon the fact that the role of fixation is given to each eye in turn. The stimulus received by the retina of the eye fixing the text object (fixation reflex) determines the direction of both visual axes when the other eye is screened."

When Dolman's data are subjected to statistical analysis, it becomes obvious that his conclusions, drawn on analysis of percentages only, are erroneous. Actually there is in Dolman's data no significant difference between results of testing with the Maddox rod before first the dominant eye and then the nondominant eye. Clinical testing for heterophoria varies in this respect. Placement of the Maddox rod before the dominant eye is recommended by many clinicians on the assumption that occlusion of the habitually fixing eye more completely disrupts fusion. Others routinely place the Maddox rod before the right eye, which means that the Maddox rod is before the dominant eye about 75 percent of the time.

No significant difference was discovered between heterophoria measures with the Maddox rod placed separately before either the dominant or the nondominant eye under any condition tested in this study. The average with the rod before the dominant eye was 1.50 prism diopters of esophoria, and before the nondominant eye was 1.62 prism diopters of esophoria. This similarity exists with or without screening, and with the red or with the white Maddox rod.

Dominant vs. nondominant eye at 13 inches. There was no significant difference between heterophoria measured with the Maddox rod placed separately before either the nondominant or the dominant eye at 13 inches. When the rod was before the dominant eye, the average was 5.02 prism diopters of exophoria, and when the rod was before the nondominant eye the average was 4.92 prism diopters of exophoria. This similarity in heterophoria reading is present with or without screening, and with a red or with a white rod.

It does not appear necessary to designate whether the dominant or the nondominant eye shall be used in the routine testing for heterophoria, at 20 feet or at 13 inches. This conclusion is consistent with Dolman's[5] data.

Red vs. white Maddox rod at 20 feet. The color of the Maddox rod used to measure heterophoria may be important in testing because the human eye is approximately 0.5 diopter hypermetropic for the color red.[9] Thus the eye should accommodate 0.5 diopter more in clearly imaging a line seen through a red Maddox rod than one seen through a white Maddox rod. This increased accommodation should create an increased convergence tendency which may manifest itself as esophoria. Thus if a red rod is used instead of a white one, we may logically expect exophoria to decrease and esophoria to increase. A white rod should theoretically yield a more accurate measure for this reason. Another argument for the use of the white Maddox rod instead of the red one is that the white rod is usually far more optically accurate than the red by virtue of the production methods utilized for the two rods.[5]

In this study, changing from a red to a white rod was, on the average, equivalent to subtracting 0.25 prism diopters of

esophoria from the reading. With the red rod, the average reading was found to be 1.68 prism diopters of esophoria; with the white, it was 1.43 prism diopters of esophoria. The difference is statistically significant.

This difference due to color of the rod was found to exist when the rod was before either the dominant or the nondominant eye. With the rod before the dominant eye, the change from a red to a white rod produced 0.30 prism diopters less of esophoria; with the rod before the nondominant eye, the change produced 0.20 prism diopters less of esophoria. Likewise, the difference introduced by the color of the rod persisted in the presence or absence of screening. With screening, the white rod gave 0.21 prism diopters less of esophoria than the red rod, without screening, the white rod gave 0.30 prism diopters less. The difference between the red and the white rod is a little less than the 0.50 prism diopters expected on theoretical grounds.

For routine determinations of lateral heterophoria, it appears to be important to specify the color of the rod which is to be used in the testing at 20 feet.

Red vs. white Maddox rod at 13 inches. Changing the color of the rod did not significantly change the heterophoria reading at 13 inches. With a red rod, the average was 5.08 prism diopters of exophoria, and with a white rod, 4.87 prism diopters of exophoria. This similarity was found both in the presence and absence of screening, and with either the rod before the dominant or the nondominant eye. For determinations of heterophoria at 13 inches, therefore, it does not appear to be necessary to designate the color of the Maddox rod.

The fact that the color of the Maddox rod makes a significant difference at a testing distance of 20 feet but none at 13 feet can be explained on logical grounds. At 20 feet, the patient is using a minimum of accommodation and the increase of 0.5 diopter necessary to image clearly the red rod's line is sufficient to become manifest as an increase in esophoria. At 13 inches, however, a minimum of 3 diopters of accommodation is being exerted and the added 0.5 diopter necessitated by changing from a white to a red Maddox rod is not sufficient to become manifest as more esophoria.

Correlation of measurements

Correlation between measurements of heterophoria at 20 feet. While an average increase of 0.37 prism diopters was introduced by the use of the screening, this amount of change did not occur exactly for each subject under each of the combinations of testing conditions. The high uniformity of the change, however, may be seen from product-moment coefficients of correlation in Table 6. The correlation coefficients between the screening and not screening measurements average about +0.90, which is equivalent to saying that knowledge of heterophoria determined without screening may be used to predict heterophoria with screening with a high degree of accuracy. Similar correlation coefficients for the red-rod versus the white-rod tests, and for the rod before the dominant eye versus the rod before the nondominant eye likewise show high relationships for these testing conditions.

To facilitate transformation of heterophoria readings taken at 20 feet with screening into readings without screening, linear regression coefficients are included in Table 6. To illustrate the use of the regression coefficients, assume that a measurement of heterophoria was made on a single individual with a light at 20 feet and a red rod before the nondominant eye, using screening. Assume further that it is desired to transform this measurement into that expected if screening had not

been used. The regression of not screening on screening (b_{es} in table 6) is 0.98 for these conditions, which says that for each diopter change in heterophoria measured with screening, there is on the average 0.98 prism-diopter change in the same direction without screening. Substitution in the above formula will accomplish the desired transformation.

FORMULA

$$\begin{matrix}\text{Predicted heterophoria without screening}\end{matrix} = \begin{matrix}\text{Average heterophoria without screening}\end{matrix} + \begin{matrix}\text{Regression of screening on non-screening}\end{matrix} \left[\begin{matrix}\text{Observed heterophoria with screening}\end{matrix} - \begin{matrix}\text{Average heterophoria with screening}\end{matrix} \right]$$

Taking the appropriate values for the conditions specified (red rod before nondominant eye), gives:

Predicted = 1.55 + 0.98 (Observed − 1.89)

Assume that 4 prism diopters of esophoria were observed in a subject with screening. The predicted heterophoria for this subject without screening is 3.6 prism diopters of esophoria.

Correlation between measurements at 13 inches. The correlation coefficients for the intensity of the relationship between measurements at 13 inches are sufficiently high to enable accurate prediction from a measurement taken under one circumstance to a measurement taken under another (table 6).

Correlation of Maddox-rod tests with the screen and parallax tests at 20 feet. The screen and parallax test using a light source at 20 feet from the subjects gave an average of 0.64 prism diopters of esophoria (table 7). This is about one diopter less than the average of the eight variations of the Maddox-rod tests. The measurements of heterophoria by the eight variations of the Maddox-rod test correlate equally well with measurements made by the screen and parallax test. At first glance, there appear to be higher correlations between the screen and parallax test and all variations of the Maddox-rod test when the rod is before the nondominant eye than when the rod is before the dominant eye. The difference between the corresponding correlations was found to be nonsignificant (by z transformation). There is consequently no obvious advan-

TABLE 6

CORRELATION COEFFICIENTS AND REGRESSION COEFFICIENTS FOR MADDOX-ROD TEST

Variables		20 Feet			13 Inches		
i	j	Correlation r_{ij}	Regression b_{ij}	Regression b_{ji}	Correlation r_{ij}	Regression b_{ij}	Regression b_{ji}
A. With screening *vs.* without screening							
1	2	0.88	0.87	0.89	0.87	0.83	0.91
3	4	0.90	1.00	0.81	0.89	0.84	0.94
5	6	0.95	0.92	0.98	0.84	0.78	0.90
7	8	0.88	1.07	0.72	0.83	0.83	0.83
B. Red rod *vs.* white rod							
1	3	0.93	0.92	0.94	0.88	0.89	0.87
2	4	0.93	1.04	0.84	0.89	0.89	0.89
5	7	0.93	0.96	0.90	0.91	0.90	0.92
6	8	0.91	1.17	0.71	0.92	0.97	0.88
C. Dominant eye *vs.* nondominant eye							
1	5	0.80	0.71	0.90	0.90	0.84	0.96
2	6	0.78	0.68	0.90	0.80	0.73	0.88
3	7	0.88	0.81	0.96	0.89	0.81	0.98
4	8	0.83	0.84	0.82	0.80	0.77	0.84

n = 100 subjects.
The numerals used to designate the variables may be identified on the table of means (table 4).
b_{ij} is the regression of i on j.
b_{ji} is the regression of j on i.

tage of testing with the nondominant eye. Further, there is no general advantage of the screen Maddox-rod test over the Maddox-rod test alone (without screening) so far as the correlation with the screen and parallax test is concerned.

Correlation of the Maddox-rod tests with the screen and parallax test at 13 inches. With respect to correlations with the screen and parallax test there is no obvious choice among the variations of the Maddox-rod test at a testing distance of 13 inches (table 7). However, in this sample, the correlations are all higher than the correlation found in the previous experiment (table 2). No obvious explanation for this discrepancy has occurred to us.

At this testing distance, the results in this experiment agree with those for a previous experiment summarized in Table 2, where the correlation between the screen Maddox-rod test and the screen and parallax test was found to be 0.81.

TABLE 7

CORRELATION OF SCREEN AND PARALLAX TEST WITH EIGHT VARIATIONS OF THE MADDOX ROD

	20 Feet	13 Inches
Screen and Parallax test		
Mean $\bar{x}$	+0.64 Diopter (eso.)	−8.07 Diopter (exo.)
Stan. Dev. s_x	1.70	5.99
Correlation Coefficients of Screen and Parallax Test with Maddox Tests.		
D—R—S	+0.56	+0.60
D—R—O	+0.60	+0.59
D—W—S	+0.73	+0.64
D—W—O	+0.65	+0.60
N—R—S	+0.82	+0.77
N—R—O	+0.77	+0.70
N—W—S	+0.76	+0.73
N—W—O	+0.77	+0.79

n = 100 subjects.
D = rod before dominant eye
N = rod before nondominant eye
R = red rod
W = white rod
S = with screening
O = without screening

TABLE 8

ANALYSIS OF VARIANCE FOR HETEROPHORIAS AT 20 FEET AND AT 13 INCHES; 100 SUBJECTS TESTED 16 TIMES; THAT IS, AT TWO DISTANCES, WITH AND WITHOUT SCREENING, WITH RED AND WHITE RODS, AND WITH ROD BEFORE THE DOMINANT AND THE NONDOMINANT EYES

Source	df.	20 Feet		13 Inches		$F_{.01}$
		Mean Square	F	Mean Square	F	
Screening (with-without) K	1	27.75	54.41	31.60	11.05	6.70
Lighting (red-white) M	1	12.75	25.00	9.46	3.31	6.70
Eyes (dom.-nondom.) O	1	3.00	5.88	1.53	—	6.70
Subjects, N	99	s_n^2 = 50.98	99.96	s_n^2 = 215.40	75.31	1.42
K×M	1	0.45	—	7.41	2.59	6.70
K×O	1	0.06	—	10.35	3.62	6.70
K×N	99	1.55	3.04	9.63	3.37	1.42
M×O	1	0.45	—	0.45	—	—
M×N	99	0.92	1.80	6.10	2.13	1.42
O×N	99	4.00	7.84	10.37	3.63	1.42
Remainder	397	s_e^2 = 0.51		s_e^2 = 2.86		
All interactions	697	s_g^2 = 1.21		s_g^2 = 5.36		
Estimate of reliability, based on s_n^2 and s_g^2, r_{tt}		= 0.976		= 0.975		

NOTE ON STATISTICAL METHOD

These two experiments, at near and distance fixation, are factorial in type with three factors being tested at each of two levels. When it was found that the variances of heterophoria at 20 feet constituted a homogeneous set which was definitely different from the variances at 13 inches, the data for the two distances were kept separate. This made it possible to use the method of analysis of variance to detect the main effects of screening, eye dominance, and rod color, as well as the interactions of these factors. The results of the statistical analysis are summarized in Table 8, in which evidence is contained for each of the assertions about significance or nonsignificance of the difference made in the preceding sections.

The design of this experiment also makes possible an estimate of reliability of the measurement of heterophoria using the methods of internal consistency proposed by Hoyt.[6] For heterophoria measured with a testing distance of 20 feet, the reliability coefficient was 0.976, and with a distance of 13 inches the coefficient was 0.975.

SUMMARY

1. The reproducibility or reliability of measurements of heterophoria when taken by two examiners using the screen Maddox-rod test was found in one sample of aviation cadets to be satisfactorily high. The coefficients of reliability were +0.95 for lateral heterophoria and +0.92 for vertical heterophoria at a testing distance of 20 feet. In another sample, after removal of systematic effects due to the use of screening and to changing the color of the rod, the Maddox-rod test both at 20 feet and at 13 inches had a reliability coefficient of +0.97 for lateral heterophoria.

2. There is no significant difference in results obtained by two different examiners in administering the screen Maddox-rod test.

3. Several tests for heterophoria were compared with the screen and parallax test, which is considered the most accurate test. At a testing distance of 20 feet, a high correlation was found with von Graefe's prism diplopia test and with the screen Maddox-rod test. At a testing distance of 13 inches, a high correlation was found with von Graefe's prism diplopia test, the Maddox-wing test, and the Thorington test. The correlation with the screen Maddox-rod test was somewhat lower in one experiment, but high in another.

4. The effect of varying the testing conditions upon the Maddox-rod test was determined. The amount of illumination had no significant effect. It makes no difference whether the Maddox rod is placed over the dominant or the nondominant eye. At a testing distance of 20 feet, a red Maddox rod uncovers more esophoria than does a white one, but there is no difference between the effect of the red and white rods at 13 inches. With screening, the Maddox-rod test uncovers more esophoria or less exophoria than without screening.

5. The Maddox-rod test for all possible combinations of four alternative testing conditions was found to be highly correlated with the screen and parallax test.

6. The following conclusions may be drawn from the results.

a. Heterophoria measurements may be performed with sufficient accuracy to discriminate between individuals.

b. The Maddox-rod test gives results sufficiently like those of the screen and parallax test to be used as a replacement for it for purpose of routine testing.

c. It is recommended that the Maddox-rod test be performed with a white rod, without screening, and without regard to placing the rod before the dominant or nondominant eye for purposes of routine testing.

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ACUTE GLAUCOMA: A FOLLOW-UP STUDY*

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As part of an effort to emphasize the fallacy of fitting newer knowledge of glaucoma to an accepted classification, rather than fitting the classification to our newer views regarding glaucoma, I reviewed, in 1940, a series of 49 cases[1] of acute glaucoma. It was pointed out in that paper that an acute glaucomatous attack frequently starts without congestion and only after the vascular system of the eye no longer can tolerate the high tension and accumulation of metabolic products does congestion supervene. I concluded that the classification of acute glaucoma as congestive glaucoma is unjustifiable and suggested that the presence or absence of congestion be designated in an auxiliary diagnosis; for example, acute glaucoma—congestive phase, or acute glaucoma—non-congestive phase, as the case may be. A review of this same series of cases after a period of six years is presented, since it revealed further justification for the above conclusions, as well as rather interesting observations on the course of acute glaucoma and the provocative tests for this condition. An addition to the therapeutic approach is suggested as a result of this study.

Since the case histories of the series were published in the original presentation, only those cases in which pertinent information has been added will be reviewed. In addition, a few cases not of this series are included in this paper to emphasize particular points under discussion.

Of the 49 patients in this series, four were instances of acute glaucoma due to lenticular intumescence. All of these were treated surgically and required no further follow-up from the viewpoint of this paper. Therefore, all of the following considerations will concern only the remaining 45 patients with "primary" acute glaucoma. Of these, 17 had had surgical treatment to both eyes at the time the original study was published. Four others could not be followed (cases 12, 19, 34, and 43). Thus, a total of 21 patients (46.6 percent) did not contribute to the follow-up study. Of the remaining 24 patients, 12 (cases 8, 10, 11, 17, 21, 29, 30, 31, 35, 36, 37, and 45) showed no significant

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change from the time of the original study, and 12 (26.6 percent of the total) showed some significant change during the six-year follow-up interval. The latter are here reviewed in detail. The case numbers are the same as in the original, published study.

Case histories

Case 2. This 44-year-old woman had experienced blurring of vision with the left eye during and after seeing motion pictures for two years before coming to the Illinois Eye and Ear Infirmary (hereafter referred to simply as the Infirmary). Occasionally, the blurring was accompanied by ocular pain, nausea, and vomiting. There was never any redness of the eye. During the same period, reading had caused enough discomfort to cause her to avoid it. Two days after being refracted under homatropine cycloplegia at the Infirmary in 1940, she awoke during the night with a headache. The eyes were not red. The following morning, the patient was nauseated and vomited, but the eyes were still pale. The patient went to the Infirmary the same day, where the tension in the left eye was found to be 60 mm. Hg (Schiøtz). Miotics were promptly effective in reducing the tension to normal. Provocative dilatation of the right eye with a 2-percent homatropine-hydrobromide solution was ineffective in raising the tension in three hours.

In spite of the continuous use of pilocarpine instillations once daily, this patient experienced an acute attack of glaucoma in the left eye after an emotional upset on April 1, 1944. Pain was severe for 12 hours. The eye was pale. An iridencleisis operation was performed to relieve this attack. The tension was controlled thereafter with the use of pilocarpine. A repeated provocative dilatation of the right pupil with homatropine-hydrobromide (2 percent) solution was ineffective in raising the tension in two hours.

Case 6. This 56-year-old man became aware of pain and blurred vision in his right eye in January, 1939, while playing cards. The eye was not red until the following morning. No treatment was sought for two weeks. Four weeks after the onset of the attack, examination at the Infirmary revealed a stony-hard eye which responded only to surgical treatment. Provocative dilatation of the left eye with paredrine for three hours was ineffective in raising the tension. Both chambers were shallow.

On June 15, 1942, the tonometric readings were: R.E., 24 mm. Hg (Schiøtz); L.E., 77 mm., in spite of the use of pilocarpine. Vision in the left eye had become blurred two weeks previously. An iridectomy was done on June 25, 1942. The tonometric readings remained normal until the patient left the state in November, 1944.

Case 9. This 62-year-old woman began to notice halos and occasional headaches whenever returning home from attending a motion picture theatre in November, 1938. The eyes were never red, and the symptoms were always relieved by cold applications. In August, 1939, while on a trip, the right eye became painful, and later red. An oculist whom she consulted referred to the condition in a letter as acute glaucoma. The use of miotics was successful in relieving the attack within four hours after beginning treatment. On returning from the trip, the patient was seen at the Infirmary. Tension in the right eye was 80 mm. Hg (Schiøtz), but the eye was not red. Miotics promptly reduced the tension to normal. A similar blurring and pain involved the right eye on April 15, 1940. The increased tension was promptly reduced to normal with miotics. The eye was not red.

Provocative dilatation of the pupil of

the left eye with paredrine and homatropine solutions was ineffective in causing an acute glaucomatous attack. The pupil could not be dilated beyond 4.5 mm. in 3¼ hours.

In spite of the continuous use of pilocarpine, this patient experienced another acute attack in the right eye on July 30, 1945. The tension was: R.E., 84 mm. Hg (Schiøtz); L.E., 22 mm. Tension in the right eye was reduced to 31 mm. by the next day but it returned to 54 mm. three days later. On August 6, 1945, an iridencleisis was performed on the right eye. This, together with the use of pilocarpine, controlled the tension.

A repeated provocative dilatation of the pupil of the left eye with a 2-percent homatropine-hydrobromide solution was ineffective in raising the tension in two hours.

Case 15. This 60-year-old woman noticed blurring and pain in her right eye, followed by headache and vomiting, on November 3, 1939, after weeping. Three days after the onset, the ocular hypertension was reduced to normal with miotics. The left eye was unaffected. Provocative dilatation of the pupil of the left eye, in 1940, caused an acute ocular hypertension which was relieved quickly with one drop of 0.25-percent eserine. The eyes remained normal on miotic therapy until March 5, 1941, when this patient appeared after having had pain, redness, and decreased vision in the left eye for three days. The tonometric readings were: R.E., 20 mm. Hg (Schiøtz); L.E., 80 mm. The tension was reduced to normal rapidly with 2-percent pilocarpine-nitrate instillations. This patient was able to seek private medical care so further follow-up was not possible.

Case 16. This man, aged 69 years, in 1941, experienced his first attack of glaucoma one afternoon in 1938. He had pain and headache on the left side of the head. This was successfully relieved by the application of heat. Five days later, shortly after awakening, another attack occurred. The eye was not red until later in the day. The pain and blurring of vision which were present at the onset continued less severely for five weeks before the patient was seen at the Infirmary. Miotics were ineffective, and a trephining operation was successfully done on the left eye on February 25, 1938. The right eye had a tension of 52 mm. Hg (Schiøtz) on July 3, 1940. This was promptly normalized with miotics. Provocative dilatation of the pupil of the right eye, in 1940, with paredrine and homatropine solutions was ineffective in raising the tension above 21 mm. Hg. However, on August 31, 1940, tension in the right eye was 53 mm. This was normalized with pilocarpine. Again, on April 29, 1942, tension in the right eye was 46 mm. and on June 10, 1942, while the patient had been using eserine (0.5 percent) the tension was 67 mm. An iridectomy was done on the right eye. The tension then remained normal until the patient's death in April, 1943.

Case 18. This 51-year-old woman experienced her first ocular symptoms in July, 1940, while viewing a movie. The eyes were not red, but the vision was blurred. Reading frequently caused blurring of vision. When first seen at the Infirmary in December, 1940, tension was: R.E., 70 mm. Hg (Schiøtz); L.E., 46 mm. Both eyes were pale. Miotics caused reduction of tension to normal within 30 minutes. On December 21, 1940, after being asked not to use the prescribed pilocarpine in the right eye that morning, the patient's tension was 60 mm. in the right eye, and 28 mm. in the left. Miotics reduced the tension of the right eye from 60 to 24 mm. Hg within 20 minutes. Provocative dilatation of the pupil of the left eye with 2-percent euphthalmine on January 9, 1941, caused a rapid rise in ten-

sion from 28 mm. Hg to 60 mm., in 30 minutes. Repeated attacks of high tension in the right eye occurred on April 12, 1942, and on four occasions in February, 1944, despite the punctual use of pilocarpine and eserine, 5 to 8 times daily, as directed to do at various times. The eyes were always pale. This patient was put on a combination of 1-percent neosynephrine, 0.25-percent physostigmine salicylate, and 2-percent pilocarpine nitrate, 6 times daily. During a two-month period of observation, this patient experienced two attacks of hypertension, each of which was relieved after further instillations. This patient felt that the addition of neosynephrine was of some help; however, I could not be certain of its value in this case.

Case 22. This 45-year-old woman had experienced pain in her left eye about three times weekly for three years before being seen at the Infirmary in 1939. These episodes were sometimes associated with excitement and sometimes occurred after attendance at a motion-picture theatre. The pain usually lasted overnight and was never associated with redness of the eyes. On June 24, 1939, a homatropine refraction was done, following which the tension was found to be: R.E., 40 mm. Hg (Schiøtz); L.E., 80 mm. The eyes were pale. Miotics reduced the tensions to normal within an hour. Provocative dilatation of the pupil of the left eye with 2-percent euphthalmine subsequently caused an acute ocular hypertension, yet the eye remained free of any injection. Tension rose from 26 mm. Hg to 57 mm. in 40 minutes.

On February 24, 1941, the patient experienced a sudden attack of pain, redness, halos, and headaches which lasted for two days before she was seen at the Infirmary. Tension was 68 mm. Hg (Schiøtz) in the left eye despite the use of pilocarpine. This was relieved with miotics. On October 20, 1941, associated with the serious illness of a close relative, the patient experienced another similar attack in the left eye. This was relieved by bilateral iridectomy-sclerectomies.

Case 23. This 50-year-old man noticed halos after seeing motion pictures two months before the onset of a severe attack of acute glaucoma. The halos disappeared by the following morning. The eyes were not red. On the night of December 19, 1940, the patient did not sleep well. At 10 o'clock the next morning the right eye was very painful and swollen. Miotics given the following day were ineffective in reducing the tension. An iridectomy-iridencleisis was performed on the fifth day. Two separate attempts to provoke acute glaucoma by dilatation of the pupil of the left eye with euphthalmine, paredrine, and homatropine solutions were unsuccessful. The pupil could not be dilated beyond 6.5 mm.

On December 30, 1944, the patient was awakened at 2:30 o'clock in the morning by pain in the left eye. He had been using doryl drops, three times daily. The eye was red and hard when seen at the Infirmary on January 1, 1945, when an iridencleisis was performed.

Case 24. This 57-year-old woman had noticed ocular discomfort after seeing motion pictures or after reading for several months previous to being seen at the Infirmary on February 21, 1938. A week before admission, her right eye was red and painful on awakening one morning. The symptoms continued for a week. When seen at the Infirmary, tension in the right eye was 60 mm. Hg (Schiøtz). Miotics were ineffective in reducing the tension below 40 mm. An iridectomy was performed four days later. Provocative dilatation of the left pupil in April, 1946, caused an increase of tension from 23 to 39 mm. in 2½ hours.

Case 27. This 27-year-old man had experienced blurring of vision, pain, and often slight injection of the right eye in-

termittently about twice weekly since the age of 17 years. These episodes usually occurred after attending a motion-picture theatre or after reading, usually at night. On November 29, 1938, a homatropine refraction was done at the Infirmary. The pupil of the right eye never returned to its normal diameter. Two days after the refraction examination, the patient began to have pain and slight injection of the right eye. When seen at the Infirmary four days later, the tonometric reading for the right eye was 60 mm. Hg (Schiøtz). The eye was very slightly injected. Miotics were ineffective in reducing the tension to normal. A trephining operation done on January 11, 1939, on the right eye was unsuccessful. It was followed on February 8, 1939, by cyclodialysis of the right eye. This was successful. The cleft was visible gonioscopically. However, nearly four years later, on December 8, 1942, tension in the right eye was elevated to 52 mm. Hg (Schiøtz). On eserine therapy, the tension returned to normal and has remained normal since on miotics. The cyclodialysis cleft is open but shallow.

This is probably the youngest case of true acute glaucoma on record, having started with prodromata at about the age of 17.

Case 32. This 73-year-old man awoke one morning with blurring of the vision of the right eye, slight injection of that eye, and slight headache. He went to the Infirmary the next day, after the eye had become worse. It was then red and the tension was 70 mm. Hg (Schiøtz). Miotics were only temporarily effective. A trephining was done in October, 1940. Provocative dilatation of the pupil of the left eye was ineffective in causing glaucoma. The pupil could not be dilated beyond 5 mm. In June, 1946, this patient was sent a card requesting his appearance for examination as a part of this study. When seen, the eyes were pale. Tension in the right eye was well controlled. Tension in the left eye was 60 mm. Hg (Schiøtz). The retinal arteries pulsated. The tension was reduced to 27 mm. within one hour after instillation of a drop of 0.5-percent eserine. The patient stated that he had seen halos during the past two months. The eye had never been red. He had not used miotics for several months.

Case 40. This 60-year-old man experienced aching of the right eye without blurring of vision or redness of the eye one evening after supper in July, 1939. He awoke the next morning with the right eye red and its vision blurred. Three or four days later he consulted a physician, who referred him to the Infirmary. The tension in the right eye was 82 mm. Hg (Schiøtz). Miotics were ineffective. An iridotasis was performed on August 12, 1939. Provocative dilatation of the left eye with paredrine and homatropine solutions for three hours caused no increase in the tension. The pupil did not dilate beyond 6 mm. The miotics were stopped after the operation on the right eye.

On January 28, 1945, the patient experienced a typical attack of acute glaucoma in the left eye. Miotics were effective in reducing the tension to normal. On March 1, 1945, in spite of the use of miotics, the patient experienced another such attack in the left eye. On March 10, 1945, a left iridencleisis was done.

Discussion of these cases

The discussion of these cases will be considered under two main headings: I. The relation of acute glaucoma to narrow-angle glaucoma in general. II. Miotics in acute glaucoma.

I. The relation of acute glaucoma to narrow-angle glaucoma in general

In recent years, there has been a tendency to substitute the term *narrow-angle glaucoma* (Barkan) for the previous classification of acute and chronic-congestive

glaucoma. This is a definite advance in our thought and helps avoid the inclusion of a description of the vascular reaction of the eye in the diagnosis. Yet the terms are, strictly speaking, not synonymous, since narrow-angle glaucoma covers a wider range of cases:

1. Classical "acute congestive glaucoma"
2. "Chronic congestive glaucoma"
3. Dilatation glaucoma
4. "Preglaucoma"
5. Acute glaucoma due to lenticular intumescence
6. Acute glaucoma due to dislocation of the lens into the anterior chamber
7. Mixed glaucoma (including acute glaucoma as one form)

I, therefore, do not ordinarily use the term but prefer to include the first four conditions listed above in the term "primary" acute glaucoma and to consider the others separately. Demonstrations of the relationship between the first four is the basis of this grouping and is one of the purposes of this paper.

The fallacy of using the terms congestive and noncongestive as part of the diagnosis has already been pointed out.[1] In the follow-up study herein described, three (cases 2, 18, and 32) of the 11 patients with spontaneous attacks of acute glaucoma had no externally visible ocular congestion. One patient (case 32) was found only accidentally to have an obstructed angle and acute glaucoma. He had no complaints. The eye was not red. In Case 18 the angles were so shallow that on previous occasions it was possible to bring the intraocular pressure quickly to a high level simply by avoiding a single instillation of the miotic being used. The clinical picture and history in Cases 2 and 18 were typical of "acute congestive glaucoma," in that they had spontaneous attacks of high intraocular pressure and shallow angles which became obstructed, but atypical in the absence of congestion. By avoiding the term describing the absence or presence of congestion, these cases can be properly classified.

The confusion is emphasized in Case 17 in which a woman, then 44 years of age, had an acute glaucomatous attack in the right eye in January, 1935. The eye was not red. It was treated surgically. The diagnosis was acute glaucoma. Five years later, during a study of the other eye, the resident, in reviewing the original history of the acute episode, made a note on the hospital record stating that the original diagnosis must have been incorrect because the eye had been pale, and that the diagnosis should have been "chronic compensated glaucoma." That the diagnosis of acute glaucoma was correct is shown by the presence of a typical cataracta glaucomatosa acuta (Glaukomflecken of Vogt) in the right eye.

The relationship between the congested and noncongested eyes with acute glaucoma will be further demonstrated in the discussion of the relationship between the first four groups listed above.

The Relationship between Acute Glaucoma and *Chronic Congestive Glaucoma.*

I consider "chronic congestive glaucoma" to be a form of ordinary acute glaucoma in which the episodes recur repeatedly and then subside. When one of the attacks persists, it is considered, of course, an acute attack, but it is in the prodromal period that diagnostic confusion appears. In going over the records of this series of 45 cases of acute glaucoma, 24 were found to have had prodromal episodes. Some had been diagnosed as chronic congestive glaucoma during one of the prodromal attacks while others, in whom the episode was still in a noncongestive phase, were called "chronic compensated glaucoma" (which I have always considered to be synonymous with

glaucoma simplex). However, when an ultimate acute persistent attack occurred in these cases, the diagnosis then became acute glaucoma.

An example will suffice. B. M., a 66-year-old man, in 1939, first noticed episodes during which he experienced decreasing vision, headaches, and saw rainbows about lights, in 1937. He finally had an acute glaucomatous attack, with slight injection of the left eye, in June, 1939. This was successfully treated by trephination. The case history was not included in the original series of cases only because the diagnosis of "chronic incompenstated glaucoma" had been made. Tension in the right eye remained below 15 mm. Hg (Schiøtz) on five examinations from October, 1940, through March, 1941. Then, on April 15, 1941, a typical acute attack occurred in spite of the continuous use of pilocarpine. The eye did not respond to pilocarpine and eserine. A trephination was successfully performed. This case demonstrates the fact that our separation of "acute" and "chronic congestive glaucoma" has been an artificial one.

The Relationship between Acute Glaucoma and Dilatation Glaucoma.

During the period when I was privileged to organize the Glaucoma Clinic at the Illinois Eye and Ear Infirmary at the instigation of, and under the direction of, Dr. Harry S. Gradle, several instances occurred in which, after the use of cycloplegics for refraction, the ocular tension was found to be elevated to 60 mm. Hg (Schiøtz) or more. The eyes were pale, and, except for pulsation of the retinal arteries, which were clearly visible, no other abnormalities were evident. The use of pilocarpine or eserine promptly brought the tension down to normal. Attempts at classification led to the same difficulties previously mentioned because of the lack of congestion. Most of these cases were incorrectly diagnosed as "chronic compensated glaucoma" for lack of a better designation in the classification in general use.

The relation between these two types of cases is shown in this series of cases. Six had typical spontaneous acute glaucoma in one eye, and acute glaucoma following dilatation for refraction, examination, or accidentally, in the other eye (cases 1, 7, 8, 14, 36, and 41). The histories of the presence or absence of congestion indicated that, in all instances where dilatation was the cause of the acute attack, the eye was pale for one to two days before the pain and redness began. More specific relationship between the two groups is evident from the history in Case 2 in which one eye first had an attack of acute glaucoma following dilatation of the pupil before refraction, and four years later, the same eye was involved in a spontaneous attack.

I am convinced that there is no difference in the pathologic conditions in spontaneous typical acute glaucoma and acute glaucoma following dilatation. Here again the absence of congestion should be of no significance in the classification. If the situation is recognized during the early noncongestive phase and the tension is relieved by miotics, there is difficulty in calling the condition "acute congestive glaucoma." However, if the eye is seen after a longer period and is in a congestive phase, that term would fit.

The cases of glaucoma following provocative dilatation fall into the same classification. In the series considered here, two cases (24, 15) had spontaneous attacks of acute glaucoma in one eye and high tension following provocative dilatation in the other eye. In one of these, a spontaneous attack later occurred in the eye which had shown a positive provocative test. In three other cases, the same eye had a spontaneous acute attack which

was relieved and subsequently showed a positive provocative test (cases 18, 29 and 37). Since these cases were under observation at the time of the tests, the tension was brought back to normal during the noncongestive phase. If they had been allowed to remain at the high tension, some would undoubtedly have passed into the congestive phase. In Case 8, a provocative test was done with euphthalmine. The tension was 15 mm. in each eye. After one hour it was 18 mm. in each eye. The test was correctly considered to be negative by the resident, and the patient allowed to leave, but without instilling a miotic. The next day a typical congestive attack began in the right eye, requiring surgery.

As a result of the findings in the provocative tests, I pointed out in 1941[2] that provocative tests for glaucoma may be divided into two groups. One group for eyes with normal anterior-chamber depth —the caffein test (in my experience of little value), the drinking test, and the anterior-chamber puncture tests, in the order named. In another group of tests for eyes with shallow chambers and angles, the dark-room test should be done first, followed by a mydriatic test with 2-percent euphthalmine. If negative, 1-percent paredrine is then used, and, if still negative, homatropine. I pointed out that negative results from these tests are of no significance. In the series considered here, four patients had negative responses to provocative dilatations (cases 16, 23, 32, 40) but later had spontaneous acute attacks. Three of the four (cases 16, 23, and 32) had been examined gonioscopically before, during, and after mydriasis. The angles were patent but very narrow. The gonioscopic findings in these cases, as well as the majority of the other provocative tests, were previously mentioned.[1] Pointing out the relationship between positive provocative pupillary dilatation and acute glaucoma has the disadvantage of emphasizing this particular mechanical aspect of acute glaucoma. One must not lose sight of the neurovascular congestive factor which is more important in spontaneous acute glaucomatous attacks.

The Relationship between Acute Glaucoma and "Preglaucoma."

Gradle's recent paper[3] entitled "Preglaucoma" considers the term to include two forms: "first, the acute, shallow-angle type with the manifestations of acute decompensation; and second, the chronic, deep-angle form." In the case of the shallow-angle type, I believe that, during the normal interval between episodes, the term "preglaucoma" is correctly applicable, since at that time the eyes are entirely normal in their drainage mechanism. However, to call any phase of simple glaucoma "preglaucoma" is, in my opinion, not in keeping with our ideas regarding this condition, since in simple glaucoma the tension, whatever it is, is too high for that particular eye. At no time, then, are we sure that we are not dealing with active simple glaucoma. To avoid confusion, I believe the term should be used only in reference to an eye with potential acute glaucoma. Perhaps the term might better be "pre-acute-glaucoma."

Mixed Glaucoma.

Because one is dealing with a particular type of glaucoma, there is no reason why acute glaucoma may not be superimposed, if the anatomic predisposing factors are present. An elderly patient with simple glaucoma over a period of years does gradually get some shallowing of the chamber due to the increasing lens size. If the same patient has the anatomically (relatively) shallow chamber to begin with, he may develop an acute attack spontaneously or following dilatation. Similarly, patients with other forms of glaucoma may de-

velop a superimposed true acute glaucoma. Two cases of capsular exfoliation, with superimposed acute glaucoma follow.

J. F., a 71-year-old man, in 1939, suddenly noticed poor vision in the right eye in September, 1939. He was seen at the Infirmary where the tension was found to be 60 mm. Hg (Schiøtz) in the right eye. The anterior chambers were shallow. Eserine rapidly brought the tension to 32 mm. Typical capsular exfoliation was present in the right eye only. The right lens was removed because of cataract. The tension remained slightly above normal in spite of an open angle. This was considered characteristic of "glaucoma capsulare." In March, 1946, the patient was being prepared for removal of a cataract from the left eye, the one without capsular exfoliation. Preoperative dilatation of the left pupil caused an elevation in tension from 25 mm. to 49 mm. Hg (Schiøtz) in two hours and return to upper normal after administration of eserine. A subsequent water provocative test to help rule out the possibility of simple glaucoma was negative.

C. C., a 66-year-old man, in 1940, experienced a sudden attack of acute pain in his left eye and noticed rings around lights on May 18, 1940. This patient was seen at the Infirmary four days later. The tonometric readings were: R.E., 25 mm. Hg (Schiøtz); L.E., 73 mm. All the findings of a congestive attack of acute glaucoma were present in the left eye. Both anterior chambers were shallow. Capsular exfoliation was present in each eye. The left eye did not respond to miotic therapy and on May 27, 1940, an iridectomy was performed on this eye. The tension remained normal thereafter.

The possibility of acute glaucoma superimposed on another type of glaucoma, especially simple glaucoma, should be kept in mind. However, in the case of simple glaucoma, it is often very diffcult to be certain that a mixed type is really present. An example of what I consider to be a probable case follows:

Mrs. L. F., aged 58 years in 1945, was first seen at the University of Illinois Eye Clinic on July 18, 1945. Her corrected visual acuity was 20/20 in each eye. The right peripheral visual field with a 5 mm. white target at 170 mm. was constricted to 55 degrees, temporally; 45, superiorly; 35, nasally; and 25, below; with a nasal step to 5 degrees in the upper nasal quadrant. The left field was constricted slightly to 65 degrees, temporally; 40, above; 50, nasally; and 50, inferiorly. The anterior chambers were shallow. The tonometric readings on August 20, 1945, were: R.E., 35 mm. Hg (Schiøtz); L.E., 31 mm. A diagnosis of glaucoma simplex was made and treatment with pilocarpine instillations instituted. However, the tension stayed up, reaching 42 mm. in the right eye and 47 mm. in the left, on November 28, 1945. In January and February, 1946, the tension remained normal on pilocarpine. In May, the patient was started on di-isopropyl fluorophosphate (0.05 percent) in the right eye. The tension remained normal until May 27, 1946, when the tension was: R.E., 30 mm.; L.E., 21 mm. on June 1st, the tension was 39 mm. in the right eye; 20 mm. in the left. A drop of 0.1-percent D.F.P. was instilled. On June 3rd the tension was: R.E., 50 mm.; L.E., 23 mm. Gonioscopy at this time showed such a narrow angle in the right eye that the trabecular wall could not be seen. The patient was returned to pilocarpine therapy, and the tension was reduced. In July, the patient was seen again with an acute attack of glaucoma in the right eye. An iridectomy was performed.

II. Miotics and acute glaucoma

It appears rather significant that approximately 27 percent of a series of

TABLE 1

SIGNIFICANT FOLLOW-UP FINDINGS IN 45 CASES OF ACUTE GLAUCOMA

Case Number and Eye	Presence of Prodromata	Attack Spontaneous (S) or Due to Dilatation (D)	Provocative Dilatation 1940	Provocative Dilatation 1946	Attack during Follow-up Interval	Presence or Absence of Injection	Use of Miotics during Follow-up Interval
			E = Euphthalmine P = Paredrine HA = Homatropine				
1. R	Yes	S					
L	No	D					
2. R	No	—	HA neg.	HA neg.	—	—	—
L	Yes	D	—	—	S	Pale	Pilo
3. R	Yes	S					
L	No	S					
4. R	Yes	S					
L	Yes	S					
5. R	Yes	S					
L	?	S					
6. R	No	S	—		—	—	—
L	No	—	P neg.		S	Inj.	Pilo
7. R	No	D					
L	No	S					
8. R	No	D					
L	No	S					
9. R	Yes	S	—	—	S	Inj.	Pilo
L	No	—	P, HA neg.	HA neg.	—	—	—
10. R	No	S	—	—			
L	No	—	P, HA neg.	HA neg.			
11. R	No	—	E, P, HA neg.				
L	No	D	—				
12. R	No	—	E, P, HA neg.				
L	No	D	E positive		Could not be followed		
13. R	No	S					
L	No	S					
14. R	No	D					
L	No	S					
15. R	No	S	—		—	—	—
L	No	—	P-E positive		S	Inj.	?
16. R	Yes	S	P, HA neg.		S	Inj.	Eserine ¼%
L	No	S	—		—	—	—
17. R	Yes	S	—	—			
L	No	—	E, HA neg.	E, HA neg.			
18. R	Yes	S	—		S	Pale	Pilo
L	Yes	S	E positive		—	—	—
19. R	No	—	HA neg.				
L	No	D	E neg. HA positive		Could not be followed		
20. R	No	S					
L	No	S					
21. R	No	D					
L	No	D					
22. R	No	D	—		—	—	—
L	Yes	D	E positive		S	Inj.	Pilo
23. R	Yes	S	—		—	—	—
L	No	—	E, P, HA neg.		S	Inj.	Doryl
24. R	Yes	S		—			
L	No	—		HA positive			
25. R	No	S					
L	No	S					
26. R	Yes	S					
L	Yes	S					

TABLE 1—*Continued*

Case Number and Eye	Presence of Prodromata	Attack Spontaneous (S) or Due to Dilatation (D)	Provocative Dilatation 1940	Provocative Dilatation 1946	Attack during Follow-up Interval	Presence of Absence of Injection	Use of Miotics during Follow-up Interval
			E Euphthalmine P = Paredrine HA = Homatropine				
27. R	Yes	D			S (after cyclo)	?	No miotics
L	No	—			—	—	—
28. R	Yes	S					
L	No	S					
29. R	Yes	S	P positive				
L	No	—	P, HA neg.				
30. R	No	—					
L	Yes	S					
31. R	Yes	S	—	—			
L	Yes	S	E neg. P, HA positive	HA positive			
32. R	No	S	—		—	—	—
L	No	—	HA neg.		S	Pale	Did not use miotics
33. R	No	S					
L	No	S					
34. R	Yes	S	S		Could not be followed		
L	No	—					
35. R	No	S	P neg.				
L	No	S	—				
36. R	No	D					
L	No	S					
37. R	Yes	S	—				
L	No	S	HA positive				
38. R	Yes	S					
L	No	S					
39. R	No	S					
L	No	S					
40. R	No	S	—		—	—	—
L	No	—	HA neg.		S	Inj.	No miotics
41. R	Yes	S					
L	No	D					
42. R	No	S					
L	No	S					
43. R	Yes	S			Could not be followed		
L	No	S					
44. R	No	S					
L	No	S					
45. R	Yes	S	—				
L	Yes	S	E, HA neg.				

cases of "primary" acute glaucoma should show some important change over a period of only six years, particularly since most of the patients (8 of the 12) continued to use miotics during that time. The percentage of cases with significant change is much greater (50 percent), if one considers only the unoperated cases and those available for follow-up study. The findings in the series are shown in Table 1. In Case 2, the patient could not be considered to have been on adequate amounts of miotics. In Cases 9, 18, 22, and 23, the patients were questioned carefully to be certain that one or more instillations of the drug had not been missed on the day of the acute episode. In the three other cases, this may possibly have been what happened.

The question arises: Why, especially in view of the continued use of miotics in most instances, should patients develop

spontaneous acute glaucoma even when previous provocative dilatation of the pupil was ineffective in elevating the tension? There are several phases to the answer to this question.

First, as we have already shown,[4] patients with the anatomical predisposition to acute glaucoma become even more predisposed with the passage of time. The anatomic predisposition is due to relative shallowness of the angle of the anterior chamber which results from shortness of the eyeballs (usually manifested in hyperopic refractive errors), increased thickness of the iris or, occasionally, an abnormally small cornea and anterior segment. It has been shown[4] that there is a relationship between refractive error and anterior-chamber depth in normal eyes. In the series of cases of acute glaucoma reviewed here, I found that hyperopic error was predominant as might be expected with shallow chambers. However, this series was too small to determine this factor accurately. I, therefore, studied a series of 140 eyes with acute (narrow-angle) glaucoma* in which the refractive error was recorded. These had an average hyperopic error of 2.72 diopters. Of the 140 eyes, only seven had myopic errors, the spherical equivalents of which were −4.75, −3.62, −2.62, −2.12, −0.50, −0.12, and −0.12 in patients aged 80, 80, 73, 70, 70, 68, and 37, respectively.

The time factor results from the gradual but constant increase in thickness of the crystalline lens as new lens fibers are added. This tends to increase the shallowness of the anterior chamber. Eventually a point is reached where miotics alone keep the angle free (as in Case 18). Finally, even miotics may be ineffective but, fortunately, such cases are infrequent.

* Taken in most instances from the records of Drs. Harry S. Gradle and S. J. Meyer who kindly permitted the use of their material.

The second factor involved in the answer to our question is the congestive effect of the miotic drugs. The fact that the same drugs are used for both acute and simple glaucoma has led to the false inference that the pathologic findings in both conditions are the same. These drugs have two effects, miosis and vasodilatation.[5] The miotic action is the one which we seek in acute glaucoma while the vasodilatation effect is that sought in simple glaucoma. However, the vasodilatation factor is a disadvantage in cases of acute glaucoma where the congestion further embarrasses the already too narrow angle entrance.

Troncoso, in a recent review of Busacca's *Elements de gonioscopie normale, pathologique et experimentale,*[6] stated that "Busacca still clings to the opinion of Salzmann, who stated the belief that atropine enlarges the chamber sinus and physostigmine narrows it. Sugar has shown that the converse is true."

Actually, I have pointed out only that the converse is *also* true. The effect of either drug on the angle depends on the interplay of two antagonistic actions of each drug. Physostigmine tends to narrow the angle by its vasodilatating and its cyclotonic action but at the same time tends to open the angle by constricting the pupil. Atropine tends to widen the angle by its mechanical decongestive action but simultaneously tends to narrow the angle by increasing the iris thickness through folding.

The congestive effect of the miotic drugs is also evident clinically in patients with acute glaucoma in whom the attack is relieved by the miotic drug, but in whom, shortly afterwards, a reactive phase of increased intraocular pressure ensues, in spite of the continued use of powerful miotics. Case 9 is an instance of this. Another typical example of this follows:

Mrs. O. H. N., aged 51 years, was hospitalized at the Michael Reese Hospital in August, 1938, because of bilateral acute glaucoma. Instillations of 1-percent pilocarpine rapidly brought the tension down to less than 20 mm., but about 24 hours later tension in the right eye returned to 60 mm. Hg (Gradle-Schiøtz) shortly after the instillation of a 2-percent pilocarpine nitrate. However, by the following morning it had returned to normal. The tonometric readings are shown in Chart 1.

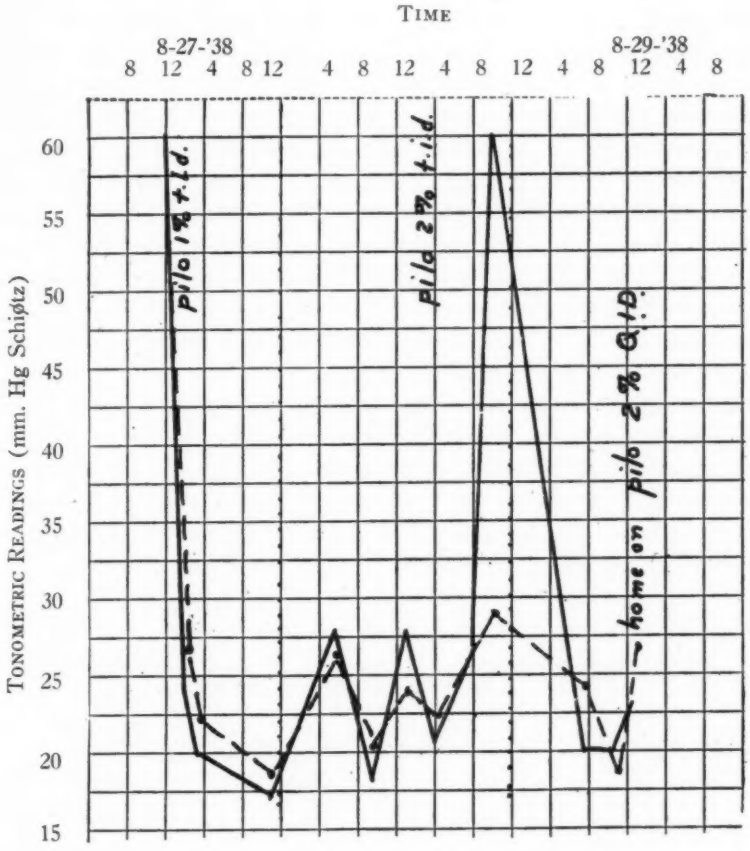

Chart 1 (Sugar). Case of Mrs. O. H. N. Instillations of 1-percent pilocarpine rapidly brought the tension down to less than 20 mm. Hg, but about 24 hours later tension in the right eye returned to 60 mm. Hg shortly after the instillation of a 2-percent pilocarpine nitrate. By the following morning it had returned to normal. (———— Right Eye. — — — — — Left Eye).

The congestive effect of the miotics is probably also the reason why pilocarpine or eserine are not always effective in preventing the onset of an acute attack in the hitherto normal fellow eye of a patient who has just had, or recently had, surgical treatment for acute glaucoma in one eye.

Two interesting examples of such instances follow:

Mrs. J. P., aged 59 years, was examined in 1941 at which time she was found to be 3.75 diopters hyperopic in each eye. The tonometric readings (Schiøtz) were 22 mm. Hg in the right eye, and 20 mm.

in the left, an hour after euphthalmine dilatation. About the end of March, 1946, this patient began to have headaches on the left side. The left vision was blurred. An antiglaucoma iridectomy was done on the following day. On April 10, 1946, I saw this patient for the first time. The tonometric readings were: R.E., 20 mm. Hg (Gradle-Schiøtz); L.E., 22 mm. Pilocarpine nitrate was ordered for instillation in the other eye as a prophylactic measure. The next morning the patient experienced an acute glaucomatous attack in each eye which required surgery.

Mrs. L. F., aged 57 years, had had episodes of dimness of vision during which she saw halos about lights for five years. When she was seen in 1936, the tonometric readings were: R.E., 50 mm. Hg (Schiøtz); L.E., 26 mm. A cyclodialysis was done on the right eye. Eserine was instilled into the left eye. At 3 o'clock the following morning the patient began to have severe nausea. By eight, the left eye became very painful. The tension was 73 mm. Hg (Schiøtz). It did not respond to miotics and a left iridectomy was done.

The obvious solution to the problem is the addition of a vasoconstrictor drug to the miotic to be used *only* in patients with shallow angles who show evidence of potential or prodromal acute glaucoma or an actual acute attack. To test the effect of such a combination of drugs I studied the duration of action and the effect on the pupil of 0.1-percent privine hydrochloride, 1-percent neosynephrine and a combination of 2-percent pilocarpine nitrate and 1-percent neosynephrine on a small series of patients, with normal eyes, between the ages of 42 and 68, the age group usually affected by acute glaucoma. The results are shown in Table 2.

The findings indicated that 0.1-percent privine and 1-percent neosynephrine have an effect on the pupil for about 3 or 3½ hours. The combination of 2-percent pilocarpine and 1-percent neosynephrine mainly manifests the pilocarpine effect which is dominant and usually "covers" the pupil-dilating effect adequately.

The combination of 2-percent pilocar-

TABLE 2

EFFECT OF DRUG INSTILLATIONS ON PUPILS OF NORMAL HUMAN EYES
(A) 1 DROP 0.1-PERCENT PRIVINE HYDROCHLORIDE

Patient	Age	Original Pupil Size	Pupil Size (mm.) After Drug Instillation							
			½ Hr.	1 Hr.	1½ Hrs.	2 Hrs.	2½ Hrs.	3 Hrs.	3½ Hrs.	4 Hrs.
1. R	54	2.3	4.0	5.0	5.5	4.0	4.0	4.0	3.5	3.2
1. L	54	2.3	4.0	5.0	5.5	4.0	4.0	4.0	3.5	3.2
2. R	68	5.0	5.0	6.0	7.5	5.5	5.0	3.5	3.5	3.5
2. L	68	5.0	5.0	6.0	7.5	5.5	5.0	3.5	3.5	3.5
3. R	50	2.3	3.0	3.2	3.5	3.0	2.3	2.3	2.5	2.5
3. L	50	2.3	3.0	3.2	3.5	3.0	2.3	2.3	2.5	2.5
4. R	55	2.4	3.0	2.5	3.0	3.0	2.5	2.5	3.5	3.0
4. L	55	2.4	3.0	2.5	3.0	2.5	2.5	2.8	3.5	3.0
5. R	47	3.5	4.0×6.0	5.0×6.0	7.0×8.0	6.0×7.0	6.0	5.0×6.0	5.0	4.0×5.0
5. L	47	3.5	5.0	6.5	8.0	7.5	6.0	6.0	6.0	5.0
6. R	45	3.0	4.0	3.5	3.0	3.5	3.0	2.7	2.7	3.0
6. L	45	3.0	4.0	3.5	3.0	3.5	3.0	3.0	3.0	3.0
7. R	67	3.0	3.0	2.7	2.5	2.5	2.2	2.5	2.5	2.5
7. L	67	3.0	3.0	2.7	2.5	2.3	2.2	2.5	2.5	2.5
8. R	45	2.5	3.0	2.5	3.0	3.2	2.5	2.5	2.5	2.5
8. L	45	2.5	3.0	2.5	3.0	3.2	2.5	2.7	2.7	2.5
9. R	49	2.5	3.0	3.2	4.0	2.5	3.0	2.5	2.5	2.5
9. L	49	2.3	3.0	3.0	3.5	2.2	3.0	2.5	2.5	2.5
10. R	56	2.5	2.3	2.5	3.0	3.0	2.5	3.0	3.0	3.0
10. L	56	2.5	2.3	2.5	3.0	3.0	2.5	2.5	3.0	3.0

TABLE 2

(B) 1 DROP OF 1-PERCENT NEOSYNEPHRINE HYDROCHLORIDE

Patient	Age	Original Pupil Size	Pupil Size (mm.) After Drug Instillation							
			½ Hr.	1 Hr.	1½ Hrs.	2 Hrs.	2½ Hrs.	3 Hrs.	3½ Hrs.	4 Hrs.
1. R	58	2.5	3.0	4.0	3.0	3.5	3.0	3.0	3.0	2.5
1. L	58	2.5	3.0	4.0	3.0	3.5	3.0	3.0	3.0	2.5
2. R	59	2.5	3.5	4.0	3.0	3.5	3.5	3.0	2.5	2.5
2. L	59	2.5	3.5	5.0	4.0	3.5	3.5	3.0	3.0	2.5
3. R	54	2.3	3.0	5.0	4.0	4.0	3.5	3.0	2.5	2.5
3. L	54	2.3	3.0	5.0	4.0	3.5	3.5	2.5	2.0	2.0
4. R	47	3.5	4.0	4.0	4.0	4.0	4.0	3.5	3.5	3.5
4. L	47	3.5	4.0	4.0	4.0	4.4	4.0	3.5	3.5	3.5
5. R	45	3.0	3.5	4.0	3.0	3.0	4.0	3.5	3.0	3.0
5. L	45	3.0	3.5	3.0	2.5	2.5	3.5	3.0	3.0	3.0
6. R	50	2.5	4.0	4.0	4.0	3.5	2.5	3.0	3.0	3.0
6. L	50	2.5	4.0	4.0	3.0	3.0	2.5	3.0	3.0	3.0
7. L	53	3.0	4.5	5.0	4.0	4.0	4.0	3.2	3.0	3.0
8. R	54	2.5	4.0	4.0	4.0	4.5	3.0	3.0	2.5	2.5
8. L	54	2.5	4.0	4.0	4.0	3.5	3.0	3.0	2.5	2.5
9. R	44	3.0	3.5	3.5	3.0	3.5	3.5	3.5	3.0	3.0
9. L	44	3.0	3.5	3.5	3.0	3.5	3.5	3.0	3.0	3.0
10. R	60	2.5	3.0	3.0	3.0	3.0	2.7	2.5	2.5	2.5
10. L	60	2.5	3.0	3.0	3.0	2.5	2.7	2.5	2.7	2.5

TABLE 2

(C) 1 DROP OF COMBINED 2-PERCENT PILOCARPINE NITRATE AND 1 PERCENT NEOSYNEPHRINE HYDROCHLORIDE

Patient	Age	Original Pupil Size	Pupil Size (mm.) After Drug Instillation							
			½ Hr.	1 Hr.	1½ Hrs.	2 Hrs.	2½ Hrs.	3 Hrs.	3½ Hrs.	4 Hrs.
1. R	62	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
1. L	62	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
2. R	62	4.0	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.5
2. L	62	4.0	4.0	4.0	3.5	3.5	3.5	3.5	3.5	3.5
3. R	48	2.5	2.5	2.5	2.5	2.5	2.5	2.2	2.0	2.5
3. L	48	2.5	2.5	2.5	2.5	2.5	2.5	2.2	2.0	2.5
4. R	45	3.5	2.0	3.0	2.5	3.0	3.0	3.0	3.0	3.0
4. L	45	3.5	2.0	3.0	2.5	3.0	3.0	3.0	3.0	3.0
5. R	60	3.5	3.0	3.5	3.5	3.0	3.0	3.0	3.0	3.0
5. L	60	3.5	3.0	3.5	3.5	3.0	3.0	3.0	3.0	3.0
6. R	56	7.0	3.0	3.0	4.0	3.5	3.5	3.5	3.8	3.8
6. L	56	7.0	2.5	2.8	4.0	3.5	3.5	3.5	3.8	3.8
7. R	42	7.0	3.5	3.0	3.5	3.0	3.0	3.0	3.0	3.0
7. L	42	7.0	3.5	3.0	3.5	3.0	3.0	3.0	3.0	3.0
8. R	50	5.0	3.0	3.0	3.5	3.5	3.0	3.5	3.0	3.5
8. L	50	5.0	3.0	3.0	3.5	3.5	3.0	3.5	3.0	3.5
9. R	58	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
9. L	58	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
10. R	48	3.0	2.5	2.5	3.0	2.5	2.0	2.0	2.0	2.0
10. L	48	3.0	2.5	2.5	3.0	2.5	2.0	2.0	2.0	2.0

pine and 1-percent neosynephrine was then used for studies on glaucoma patients. The choice of drugs is empirical. Other stronger miotics and vasoconstrictor combinations possibly would be better since pilocarpine is a rather weak vasodilator. The ideal would be a single drug with both effects. I know of no such drug, however. The recent reports of increased tension with the new drug D.F.P.[8] suggests that occasional instances of angle blockage resulting from vasodilatation and cyclotonia might be prevented by the addition of a vasoconstrictor.

TABLE 3

EFFECT OF COMBINED PILOCARPINE-NEOSYNEPHRINE AS COMPARED TO PILOCARPINE ALONE IN PATIENTS WITH SIMPLE GLAUCOMA

Patient	Findings Before Instillation			Tension and Pupil Size After Instillation of Drug											
				½ Hr.		1 Hr.		1½ Hrs.		2 Hrs.		3 Hrs.		4 Hrs.		5 Hrs.	
	Tension mm.	Pupil Size mm.		Tension mm.	Pupil Size mm.	Tension mm.	Pupil Size mm.	Tension mm.	Pupil Size mm.	Tension mm.	Pupil Size mm.	Tension mm.	Pupil Size mm.	Tension mm.	Pupil Size mm.	Tension mm.	Pupil Size mm.
1. R	23	2.0	Pilocarpine (1 drop)	20	1.5			20	1.5	20	1.5						
1. L	23	2.5	Pilo-neosynephrine (1 drop)	20	2.0			20	1.7	20	1.7						
2. R	20	2.5	Pilocarpine (1 drop)	20	1.5			19	1.5								
2. L	20	2.5	Pilo-neosynephrine (1 drop)	20	2.0			19	1.7								
3. R	23	2.5	Pilocarpine (1 drop)	20	1.5			20	1.5								
3. L	23	2.5	Pilo-neosynephrine (1 drop)	20	1.75			20	1.5								
4. R	23	2.5	Pilocarpine (1 drop)	21.5	1.5			19	1.5								
4. L	23	2.5	Pilo-neosynephrine (1 drop)	21.5	1.7			19	1.7								
5. R	26.5	1.5	Pilocarpine (1 drop)	26.5	1.0			26.5	1.0								
5. L	30	1.5	Pilo-neosynephrine (1 drop)	30	1.2			30	1.2								
6. R	27	2.5	Pilocarpine (1 drop)						2.0					20	1.5	23	1.5
6. L	27	2.5	Pilo-neosynephrine (1 drop)						2.0					20	2.0	23	2.0
7. R	27	2.5	Pilocarpine (1 drop)						2.0				2.0	25	2.0	23	2.0
7. L	26	2.5	Pilo-neosynephrine (1 drop)						2.5				2.5	23	2.0	20	2.0
8. R	17	2.0	Pilocarpine (1 drop)			17	2.0			17	2.0	20	2.0	17	2.0		
8. L	26	2.5	Pilo-neosynephrine (1 drop)			20	2.0			25	5.5	31	4.5	31	3.5		
9. R	25	1.0	Pilocarpine (1 drop)				1.0				1.0	25	1.0	23	1.0		
9. L	25	1.5	Pilo-neosynephrine (1 drop)				2.0				1.0	25	1.0	23	1.0		
10. R	23	2.5	Pilocarpine (1 drop)			17	1.5			21	1.5	20	1.7	20	2.0		
10. L	23	2.0	Pilo-neosynephrine (1 drop)			18	2.0			21	2.0	18	2.0	20	2.0		
11. R	25	2.5	Pilocarpine (1 drop)			23	1.0			17	1.0	20	1.5				
11. L	25	2.5	Pilo-neosynephrine (1 drop)			20	1.7			21	1.5	20	1.5				
12. R	21	2.5	Pilocarpine (1 drop)			17	1.5			17	1.5	23	2.0	20	2.0		
12. L	24	2.5	Pilo-neosynephrine (1 drop)			27	2.0			18	2.0	25	2.0	25	2.0		
13. R	25	2.5	Pilocarpine (1 drop)			17	1.0			17	1.0	16	1.0	17	1.5		
13. L	23	2.0	Pilo-neosynephrine (1 drop)			17	1.5			23	1.5	16	1.5	17	1.5		

The combined drug was compared with 2-percent pilocarpine alone in 13 patients with early simple glaucoma to determine whether or not the vasoconstricting factor would cause elevation of the intraocular pressure. Each patient had discontinued the use of his own miotic drugs the previous night. The findings are shown in Table 3. In 12 of the 13 cases no difference was found in the two eyes. In the remaining case (8), the combined drug caused an increase in tension from 26 to 31 mm. Hg (Schiøtz) and definite pupillary dilatation.

The combined drug was then given to 10 patients with narrow-angle glaucoma of the "pre-acute-glaucoma" type, as a substitute for the miotic drug being used. The drug was used for 4 to 6 weeks in each instance without untoward effect. Each of these patients had previously had provocative tests with mydriatics. Only one had responded with abnormal tension. He was included in the group given the combined drug. Tension in this patient's eye rose from 23 mm. Hg (Schiøtz) to 45 mm. in one hour after instilling one drop of each of 2-percent neosynephrine and 1-percent paredrine. There had been no rise of tension with pilocarpine-neosynephrine.

Actually to prove that the combination of drugs is better than the miotic alone, one would have to show that the mixture was more easily able to control patients with narrow angles who are barely controlled by a miotic alone. By the very nature of the condition this would be practically impossible to prove unequivocally. (See Case 18.)

Serr[7] studied the effect of pupillary dilatation and such drugs as pilocarpine, cocaine, and adrenalin in two cases of narrow-angle glaucoma (he designated them only as primary glaucoma and did not distinguish between simple glaucoma and acute glaucoma as separate entities). He concluded that there is a definite threshold value of pupil diameter beyond which in each particular glaucomatous eye, the angle will be blocked; also that the vasoconstrictors such as cocaine and adrenalin decrease intraocular pressure in glaucomatous eyes by first decreasing the blood volume content of the globe and then by diminishing the secretion of aqueous by a toxic effect on the ciliary epithelium. He mentions that, by simultaneous use of adrenalin and miotics, a marked lowering of tension can be brought about. From my work with provocative pupillary dilatation in acute glaucoma, I believe that Serr's idea of a definite pupil threshold is correct only for a particular circumstance and that, under varying circumstances, the threshold changes. In spontaneous acute glaucoma where a congestive factor is usually present, the pupil width necessary to increase the intraocular pressure is much less than in dilatation glaucoma. Similarly, I believe that the vasoconstrictors are effective in narrow-angle glaucoma by decreasing the iris thickness, thus tending to open the angle. I know of no evidence that the secretion of aqueous is decreased by the vasoconstrictor drugs in the human eye.

The combination of miotic and vasoconstrictor drugs is suggested as a possible aid in the treatment of the acute (narrow-angle) type of glaucoma. It is not intended as a substitute for surgical therapy. In patients suffering from a congestive attack, the vasoconstrictor drug should be used in addition to eserine or any of the other strong miotics. In the treatment of patients with narrow-angle glaucoma in the noncongestive phase, the combined drugs should not be prescribed for home use until the effect on the pupil and tension have been observed by the oculist. Since the combined effect usually lasts only about three hours,

it may be necessary to instill the drugs more frequently than when pilocarpine alone is used.

Conclusions

1. In a series of 45 patients with "primary" acute glaucoma followed over a period of over six years, 26.6 percent showed some significant change during the follow-up period.

2. From a clinical point of view, classical "acute congestive glaucoma," "chronic congestive glaucoma," dilatation glaucoma and "preglaucoma" are all so intimately related as to constitute various clinical phases of the same condition. The inclusion of descriptions of the vascular reaction of the eye in the main diagnosis is unjustified.

3. True acute glaucoma may be superimposed on other forms of glaucoma such as glaucoma capsulare and, unquestionably, even upon simple glaucoma.

4. Miotic drugs used in the treatment of acute glaucoma have the disadvantage of adding a congestive angle-narrowing factor where the angle is already anatomically too narrow. A combination of miotics with vasoconstrictors is suggested as a new approach to the therapy of acute glaucoma in all its phases.

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ARACHNODACTYLY (MARFAN'S SYNDROME) ASSOCIATED WITH ECTOPIA LENTIS

Report of a case with pigmentation of the cornea

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The clinical picture of Marfan's syndrome is that of a tall, thin individual with a saddened facies. His mobility is impaired because of muscular atrophy and faulty vision. Congenital defects are common and may involve the heart, joints, ears, lungs, ascending aorta, and palate. The muscular weakness has occasioned some investigation, and the usual finding is a normal reaction to electrical stimulation save that the response of the muscle is proportionate to the muscular atrophy.

Ocular changes are noted in about 60 percent of the cases, and include ectopic lenses, miosis with feeble or absent reaction to mydriatics, iridodonesis, variation in the intraocular pressure, divergent squint, myopia, coloboma of the lens, a thickened lens capsule, and megalocornea.

X-ray studies of the skeletal system reveal increased length of the metacarpals and phalanges, while the terminal phalanges are relatively more elongated. The long bones show no pathologic change other than elongation. Kyphosis and scoliosis are frequently observed, but perhaps this is due to relaxation of the ligaments.

Laboratory studies are usually nonrevealing, save for alteration of the cytologic elements of the blood which occurs concomitantly with the associated congenital heart or pulmonary disease. The blood pressure and the basal metabolic rate are characteristically low in this asthenic type.

Marfan,[1] the French physician, in 1896, gave the first description of the syndrome which bears his name. In this presentation, his patient was a 5½-year-old girl who had long, slender feet and hands, elongated long bones, underdeveloped skeletal musculature, contractures of the joints, and retardation of the locomotor function. For this syndrome, Marfan selected the term dolichostenomelia to describe the feet and hands as being spiderlike in configuration. In 1902, Méry and Babonneix[2] submitted the first roentgen study of the malshaped extremities of Marfan's original case, and suggested the term hyperchondroplasia in contrast to achondroplasia, because they noted enlargement of the cartilaginous portion of the epiphyses. Achard,[3] in 1902, presented the second case to appear in the literature, and first used the term arachnodactyly to indicate that the feet and hands were spiderform in shape. This term has been given preference in the literature despite Marfan's initial use of dolichostenomelia to describe the shape of the hands and feet. Since Marfan's original description, Rados,[4] in 1942, listed 204 cases which had been described through the year 1939.

The earliest description of the ocular changes is credited to Salle,[5] who, in 1912, noted the presence of narrow pupils, shallowness of the anterior chamber, and normal optic papillae. Ormond and Williams,[6] in 1923, added iridodonesis and dislocation of the lenses to the ocular findings.

The origin of this disease is entirely speculative. Dvorak-Theobald,[7] in presenting the original histopathologic study of an eye from a patient who suffered from Marfan's disease, indicates that the

aberrant process is first noted about the fourth embryonic week, at which time, according to Ida Mann,[8,9] the size of the mesodermal elements is determined by the presence of the optic vesicle. At this time some excitant is postulated by Dvorak-Theobald which causes megaloglobus. About the sixth fetal month, there is a suppression phase during which time growth and development is limited, and the trabecular tissue, dilator muscle of the iris, and pars iridica retinae are affected. It might be assumed that the skeletal abnormalities may be due to the same excitant and depressant action. Ida Mann, quoted by Morard,[10] remarks that the "disturbances in Marfan's syndrome are probably only coördinated symptoms of a genotypic affection, producing general and ocular troubles which affect not only the mesoderm but the endocrine glands and ectoderm as well." In Burch's[11] paper, Mann further reflects that "one has to remember that various factors may account for the linking of defects. In the first place, the defect may be in a certain chromosome. Since the chromosome carries many genes mediating many different characters in various parts and various tissues, it is to be expected that superficially unrelated characters may be found to be related by their genic position in the blastomeres. There is no evidence to lead us to suppose that mesodermal and ectodermal structures are segregated in different chromosomes, and there is no inherent reason why the characters for the extremities should not be carried by the same chromosomes as certain eye characters."

The histopathologic findings as described by Dvorak-Theobald[7] include megaloglobus, replacement of the dilator fibers of the iris by a "pink staining substance adjacent to the ectodermal pigment cells, incomplete formation of the pigment cells of the pars iridica retinae about half way between the iris border and the base of the ciliary body, faulty placement of the angle of the anterior chamber in that it is anterior to the canal of Schlemm, faulty development of the circular muscle of the ciliary body, and elongation of the zonular fibers, allowing the lens to assume a spheroid shape."

One of the most interesting aspects of this syndrome is the hereditary and familial tendency; about 30 percent of all cases reported manifest such characteristics. While Stewart[12] and Moore[13] have listed cases which occurred sporadically, it is generally agreed that arachnodactyly follows the Mendelian Laws, and Duke-Elder[14] states that it is a dominant characteristic.

Marfan's syndrome is so well known in the ophthalmic literature that the presentation of just another case would not be of unusual significance. In the case herewith presented, however, one finds some very unusual features. The patient, a white man, aged 52 years, first came under the observation of one of us (J. V. C.) in January, 1946. He had been blind in the right eye since he was 14 or 15 years of age but, until two weeks before admission, had been able to see with the left eye by use of a cataract-thickness lens. At that time, he observed that a film seemed to have "dropped from above," blurring his vision except when he held his head down and looked "from under a curtain."

The patient was one of eight siblings whose mother was described as a tall, thin woman who wore thick correcting lenses. Four of the children were said to be normal, with no ocular complaints, whereas four had symptoms of Marfan's disease (fig. 1).

A sister, 55 years of age, had typical arachnodactyly. On ocular examination, she was found to be blind with glaucoma in each eye, which condition dated from an attempted cataract extraction at 13

years of age. A brother, aged 45 years, was not available for examination, but was described as being thin, with long hands and feet, having trouble with his eyes, and wearing very thick lenses. A younger brother, aged 38 years, was at home, having just received a medical discharge from the Army after being in several Army hospitals for eye examination. His ocular abnormalities were discovered in the Army when he was having a foreign body removed from his eye. He had dislocated lenses, arachnodactyly, iridodonesis, wore size-11 shoes, had high patellas, a sad countenance, and the dolichocephalic head of Marfan's syndrome. The fourth affected member of the family is the patient described. The other four children,

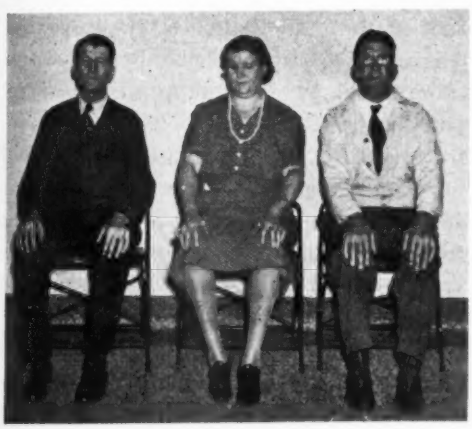

Fig. 1 (Cassady and McFarland). From left to right: the patient, his sister and brother; all with Marfan's syndrome, arachnodactyly and ectopia lentis.

their children, and one available grandchild were normal. Fortunately, three of the four afflicted individuals lived together and remained single. The fourth was married, but had no children.

Physical examination of the patient showed a tall, thin, doleful man of about 50 years of age. He had a dolichocephalic head with prominent supraorbital ridges and bossing of the frontal eminences. Subcutaneous fat was absent, and there was a flaccidness to his muscular development. There was a striking hypotonicity of the thin muscles of his arms and legs. He had long extremities, spiderlike fingers and

Fig. 2 (Cassady and McFarland). This eye shows a yellowish-brown, granular, elevated, band-shaped corneal degeneration.

toes, high patellas, a flat chest, and excessive curvature of the soles of his feet.

The right eye (fig. 2) presented the unusual feature of this patient. There was a golden-yellow, band-shaped opacity involving most of the cornea of the right eye, extending horizontally from limbus to limbus. The surface was granularly elevated like crocodile leather. There was a strip of clear cornea above and a smaller strip inferiorly; clear, that is, except for the superficial vessels to the degeneration. On closer inspection, the vascularization was from the conjunctival vessels running in from all meridians to divide arborescently and interdigitate among many small vesicles. With slitlamp examination, a transparent-droplet formation was seen piled upon the corneal surface. On retroillumination, each vesicle was outlined by a pigment ring. On diffuse illumination, the pigment formation imparted a honey-yellow color to the granular band-shaped corneal degeneration. The iris, where it was visible above, showed iridodonesis but no evidence of inflammation, degenera-

tion, or vascularization. The eye was glaucomatous, and had been blind since the patient was about 15 years of age.

On external examination of the left eye, the cornea was clear, the pupil small, round, and regular. With ocular excursion, iridodonesis was noted. The corrected visual acuity was 20/200 when the patient tilted his head forward. On ophthalmoscopic examination, one noted a complete dislocation of the lens into the lower temporal vitreous chamber, and a bullous retinal detachment from above. The detachment partially obscured the optic papilla, and extended from the 10- to 2-o'clock positions, with a horseshoe-shaped tear at the 11-o'clock position, and a slight disinsertion from 12 to 1 o'clock. As the lens bounced in ocular motion, vitreous strands extending toward the detachment seemed to pull the retina farther down or allowed it to recede, depending upon the position of the lens in the vitreous chamber.

The optic disc appeared normal, and the attached retina was of usual color and appearance. The lens was spheric and small, with glistening, cholesterinlike crystals shining on its yellow-white surface. The lens usually floated in the lower part of the vitreous, where it would drop onto the retina when the patient was recumbent. With the patient prone, or when standing or sitting, it would come to the edge of the pupil leaving only enough room for him to see a little between it and the bullous detachment.

The problem this patient presented, then, was to save what little vision he had in his only remaining eye. The detachment fastened by vitreous strands to the movable lens apparently was being pulled loose by the traction between the vitreous and the lens. The pupil would not dilate to allow even this small spherical lens to migrate into the anterior chamber. There is a lack of dilator fibers present in the iris (Dvorak-Theobald),[7] which accounts for the fact that atropine did not affect the pupillary aperture. We were able to dilate the pupil slightly by repeated instillations of adrenalin or neosynephrin with cocaine, but neosynephrin or adrenalin alone were not effective in effecting pupillary dilation.

With the small pupil, a lens removal could not be successfully performed, for the lens could not be brought through it, therefore a preliminary iris sphincterotomy was done. The iris sphincter was cut nasally and temporally in the horizontal meridian. The sphincter was thicker than normal, and, after being cut, the pupil dilated ovally.

After sufficient time for recovery, the patient was turned face down with the foot of the bed elevated to try to get the lens into the anterior chamber. It would come to the edge of the pupil below, but not through the pupillary aperture. With track sutures, therefore, a conjunctival flap, and negative pressure by the eye speculum, the lens was brought into the anterior chamber area with a Weber loupe from the lower vitreous chamber, then grasped with a capsule forceps; the extraction was completed, and the wound closed with no appreciable loss of vitreous. The eye was softer than normal as the sutures were tied. The recovery from this part of the surgery (the lens extraction), as well as the previous preliminary sphincterotomy, was followed by a moderate striate keratitis.

As the operative reaction subsided, hemorrhage in the vitreous obscured the fundus reflex. The hemorrhage organized, while some posterior synechia developed. The endothelial surface of the cornea near the wound showed a few deep blood vessels. The eye was softer than normal. Treatment with nonspecific protein and X-ray therapy did not improve the visibility of the fundus through the vitreous

haze. The vision was limited to light perception and projection.

Discussion

A diffuse pigmentation of the cornea such as was seen in this patient is of rare occurrence. The only similar instances of pigmentation of a band-shaped corneal degeneration that have been reported in the literature were those of Von der Heydt[15] and Peppmueller.[16] In their cases, there were no vascular nor inflammatory changes, and both occurred in patients with osteitis deformans (Paget's disease). The degeneration is of the outer layer of the cornea, hence, is epithelial. The pigmentation is located on the outside of the vesicles that are piled upon the corneal surface and diffusely invaded by blood vessels.

The cause for the pigmentation in this corneal lesion presents a most interesting problem. Klien-Moncreiff,[17] in a chemical analysis of the pigment present in a corneal leucoma, found it to be hemosiderin. She believes the pigment diffused downward from the superior limbus through the intercellular spaces of the corneal epithelium.

Another theory which may obtain is that the pigment is akin to melanin. In support of this, we know from Redslob's[18] studies that the basal cells of the limbal conjunctiva are all potential melanoblasts. Further, Redslob found the epithelium which covers the corneal surface to be achromogenic in normal condition; however, should a pathologic process ensue which entails vascularization, these cells become chromogenic. The query as to where the pigment arises could be answered by Bloch's[19] dopa reaction. This indicates whether a cell is a potential chromogen by its combination with 3-4 dioxyphenylalanin, or what Bloch chooses to call dopa. If the cell is a melanoblast, it is assumed to contain an oxydase ferment which, when in combination with dopa, will form a melaninlike pigment that distinguishes it as a chromogen. The blood stream is thought to be the site where dopa is carried to the cell and, when in contact with a cytoplasm of the proper type, pigment is laid down. The latter explanation would probably best fit the chromogenesis here, since the epithelial cells have undergone a cystic metaplasia wherein blood vessels freely invaded the area.

Summary

A review of the literature of Marfan's syndrome emphasizes its hereditary and familial tendency. In the family reported, four of eight children were normal, whereas four manifested the syndrome, confirming its dominant hereditary trait.

The patient herein presented not only had the predominant characteristics of the disease (arachnodactyly and ectopia lentis) but also a detached retina, pulled loose by the dislocated lens. His pupil (due to a lack of dilator fibers) would not dilate with mydriatics.

A pigmented, band-shaped corneal degeneration was the unusual feature of this case, as such pigmentation of the cornea is extremely rare. A possible explanation of the origin of the pigment is postulated.

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NOTES, CASES, INSTRUMENTS

PNEUMOCOCCIC CORNEAL ULCER HEALED IN 24 HOURS WITH PENICILLIN

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On March 22, 1946, Mrs. B., aged 62 years, was brought to me for examination. She was suffering from an ulcer in the left eye, which covered one fourth of the cornea, spreading from the 11- to the 3-o'clock positions. The ulcer had as an upper limit the sclero corneal limbus, and as a lower limit, a line with downward convexity near the center of the cornea.

The surface of the ulcer was irregular. It was covered with a grayish-white agglomeration and was eaten into. The edges were detached in places. Spreading in the lower-central dial from the 9- to the 6-o'clock positions and toward the center was a desquamated surface which penetrated deeply into the very tissue of the cornea. The remainder of the cornea was swollen with infiltrations.

In the lower part of the anterior chamber, there was a hypopyon 1½ to 2½ mm. high. The liquid in the anterior chamber was cloudy. The pupil was diminished. Chemosis and edema of the upper lid were present, as were intense perikeratic congestion, pain, tears, and photophobia. Under atropine dilatation, posterior adherences could be detected at the 9- and 2-o'clock positions. Precipitations on the anterior crystalloid could also be seen. The eyelid remained contracted in a spasm. Vision in the left eye was diminished to the perception of hand movements.

In the inner angle of the eye, on the skin of the upper lid, and at the base of the nose, there were four groups of pus eruptions. There was folliculitis in both nostrils, as well as an ulcerated area, and thickening of the nostrils with cracks in the skin. Microscopic examination of the pus showed the presence of pneumococci.

History. In the beginning of her affection, the patient had had a suppurative infection of the nostrils. About a month before she was brought to me for examination, she began to feel prickings and pains in the diseased eye. For two weeks, the patient's eye was treated with instillations and various unguents by an ophthalmologist in Sibiu. Later, she was advised to seek treatment in Bucharest.

Treatment. After anesthetizing the eye with cocaine, I irradiated the ulcer with the platinum needle. The eye was then dressed with methylene blue of Blaché. I advised the patient's son that the only hope of saving the eye was in treatment with penicillin.

After almost unsurmountable difficulties, the son was able to purchase a phial of 100,000 units of penicillin which he brought to me on March 23rd. I started immediate treatment with sodium penicillin. Into the phial, I injected 10 cc. of a 0.75-percent sodium-chloride solution. This sodium penicillin was administered as follows: (1) 10,000 units were embodied in 4 gm. of lanolin and applied under the patient's eyelid every hour for the first day. (2) 30,000 units were injected under the bulbar conjunctiva around the cornea in six successive doses of 5,000 units every four hours. (3) 60,000 units were given intramuscularly (10,000 units every four hours, six times).

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The conjunctival and intramuscular injections were administered at the same time. This treatment lasted for only 24 hours. For the next 24 hours, the penicillin unguent was applied to the eye every three hours.

Outcome. Three hours after the first conjunctival and intramuscular injections, the edema and chemosis of the eyelids had almost disappeared. The pustules and the nasal folliculitis had also begun to clear. Six hours after the first injection, the ulcer began to recede. The marginal zone around the ulcer (approximately 1 mm. wide) and the desquamated area no longer stained with fluorescein. The hypopyon was reduced to a trace.

After the third injection, the hypopyon disappeared completely. Spreading from the edge of the cornea like a pannus was a ramification of newly formed blood vessels. The corneal edema had disappeared, and the only posterior adherence was at the 9-o'clock position.

After the sixth injection, the ulcer was completely covered with newly formed blood vessels. The only congestion remaining in the eyeball was in the regions where the penicillin had been injected. The anterior chamber was clear, and the precipitants from the crystalloid had almost disappeared. Vision in this eye was now 1/6. An infiltration zone remained at the 9-o'clock position but, according to the patient, this was an old spot. She said that she could now see as well as she ever had with this eye. All the pain was gone, and there was no longer any edema of the lids.

At the end of 48 hours, I observed that the congestion of the eyeball continued to reduce and that everything was progressing toward normalcy. The ulcer was still covered with a network of newly formed blood vessels which had begun to retreat from the edge, leaving the cornea quite transparent.

Conclusions. The healing of a serious case of ulcer of the cornea in a 62-year-old woman—an ulcer which was approaching the abscess stage—was accomplished in 24 hours. The success of the penicillin treatment in this case is very impressive.

My first information on the treatment of such cases with penicillin was obtained through the American Library in Bucharest and especially from articles published in the *Ophthalmology Newsletter.*[1-5]

In La Rocca's article,[3] the quantities of penicillin used were about one tenth the amounts administered in this case. I was prompted to increase the doses because of the uncertainty of the effectiveness of the substance used. Although the label on the phial said that the penicillin was good to June 26, 1946, it also said that it should be kept at a temperature not exceeding 10°C. Since the penicillin had undoubtedly been handled by a number of black-market operators, one could be certain that this recommendation had not been observed. That is the first reason why the dosage was increased 10 times.

The second reason for the increase was to prevent the microbes from accommodating themselves to small quantities of the penicillin.

This communication is an attempt to aid in perfecting the treatment of ocular infections. The rapidity of cure in this case by administering penicillin in the very center of the infection indicates that the method is effective. Unfortunately, the lack of penicillin and its high price in our country make its use in ocular therapy an unusual event.

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PENICILLIN TREATMENT OF EYELID INFECTIONS

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Numerous articles have appeared in the literature during the past two years relating the results of treatment of infections of the eyelids, conjunctiva, and cornea with penicillin. For the most part, these results have been very favorable, and many cures have been reported. Especially favorable results were reported by Florey, McFarlan, and Mann,[1] who treated 48 cases of marginal blepharitis, 39 of which showed staphylococcus aureus on culture, by the application of penicillin ointment containing 600 to 800 units per gm. to the lid margins, three times a day. In all except one case, symptoms were alleviated, and 36 cases showed clinical recovery after three to six weeks of treatment and one year of observation. Bellows[2] reported excellent results with penicillin drops and ointment treatment of acute and chronic staphylococcic conjunctivitis. Stein[3] reported excellent results in blepharitis with penicillin ointment.

Unfavorable results have also been reported in the literature. Several authors (Vorisek and Evans,[4] Selinger,[5] Schultz,[6] Pyle and Rattner,[7] Bellows[8]) have reported allergic reactions to penicillin used locally in the eyes.

Since November, 1944, 55 cases of acute and chronic eyelid and conjunctival infections have been treated by us with penicillin used locally in the form of drops, 2,500 units per cc. in normal saline solution, as well as in the form of ointment, 1,000 units per gm. The ointment was prepared by dissolving the penicillin in a small amount of distilled water and mixing it with amber petrolatum. Wool fat or similar substances were not used. The cases in which conjunctivitis was the principal finding were treated by drops; those having a blepharitis, mainly by ointment; and those showing a blepharoconjunctivitis, by a combination of ointment and drops. The drops were used every hour during the day and also once or twice during the night. The ointment was used on the lid margins, three times a day. Several cases of acute meibomitis received, in addition to the application of ointment, hot compresses for 20 minutes, 3 times a day. The periods of observation varied from a week to 18 months.

The cases were classified as follows:

	Cases
Blepharitis, chronic	3
Conjunctivitis, chronic	17
Conjunctivitis, acute	10
Blepharitis and conjunctivitis	19
Meibomitis, acute	6

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Cultures on blood-agar plates were made in all cases except those in the acute meibomitis group. In the blepharitis cases, the cultures were taken from the lid margins just behind the lash line, after expression of the meibomian glands. In the conjunctivitis cases, cultures were taken from the lower palpebral conjunctiva.

Results of treatment

Blepharitis cases. Of the three cases in this group, two with negative cultures developed marked dermatitis of the lids after treatment for five days and were unimproved. One case with a pure culture of hemolytic Staph. aureus was markedly improved after four weeks.

Chronic conjunctivitis cases. Eight of the 17 cases in this group were cured within one week. Of these eight patients, three had negative cultures; one showed nonhemolytic Staph. aureus; three showed hemolytic Staph. aureus; and one showed Strep. viridans.

Three of the patients were well in two weeks. Two of these showed hemolytic Staph. aureus; the culture of the other was negative. Four cases were improved after two weeks. Two of these showed hemolytic Staph. aureus, and two, negative cultures. Two were unimproved. One of these showed nonhemolytic Staph. aureus and one Strep. viridans.

Acute conjunctivitis cases. Six of the 10 patients in this group were well in one week. Four of these had negative cultures; one showed both hemolytic and nonhemolytic staphylococci, and one showed hemolytic staphylococci. One developed lid dermatitis.

Two patients, both of whom showed negative cultures, were well in two weeks. One was improved after two weeks; his culture was negative, but lid dermatitis occurred. In one case, there was no improvement after three weeks. The culture showed hemolytic Staph. aureus. This case also developed a lid dermatitis which disappeared after penicillin was discontinued.

Recurrent blepharitis and conjunctivitis cases. Of the 14 cases in this group, three were well in two weeks. The cultures showed hemolytic Staph. aureus in one case and were negative in two. Four cases were improved in one week. Three of these showed hemolytic Staph. aureus. All four recurred later and were again improved by penicillin treatment.

Five cases were improved in two weeks. Two of these showed mixed cultures of hemolytic and nonhemolytic Staph. aureus; one showed nonhemolytic Staph. aureus; one showed hemolytic Staph. aureus; and the culture of one showed no growth.

Two cases were unimproved. One showed a mixed culture of hemolytic and nonhemolytic staphylococci; in the other, the culture showed no growth. Both of these patients developed a lid dermatitis while under treatment.

Chronic blepharitis and conjunctivitis cases. There were five cases in this group, two of which were cured in one week. The cultures showed hemolytic Staph. aureus. Two others were improved in two weeks. One of these showed hemolytic Staph. aureus, and the other nonhemolytic Staph. albus.

One case was unimproved after four weeks. The culture showed hemolytic Staph. aureus. Lid dermatitis developed.

Acute meibomitis cases. Four of the six patients in this group were cured in one week. One of these developed a lid dermatitis several days after treatment was discontinued. Two were improved in two weeks, but the usual chalazion remained.

Comment

Nine of the 55 cases treated developed

TABLE 1

RESULTS OF PENICILLIN TREATMENT IN 55 CASES OF EYELID AND CONJUNCTIVAL INFECTIONS

	Cured 1 wk.	Cured 2 wks.	Impr. 1 wk.	Impr. 2 wks.	Impr. 4 wks.	Unimproved
Blepharitis, Chronic					1	2**
Conjunctivitis, Chronic	8	3		4		2
Conjunctivitis, Acute	6*	2		1*		1*
Recurrent Blepharitis and Conjunctivitis		3	4	5		2**
Chronic Blepharitis and Conjunctivitis	2			2		1*
Acute Meibomitis	4*			2		
Totals	20	8	4	14	1	8

* Each asterisk equals one case of lid dermatitis.

allergic dermatitis of the lids. This is a higher incidence than is shown in ordinary drug sensitivity. Since normal saline solution and amber petrolatum were used as vehicles, the penicillin must have been the allergin. All cases of dermatitis recovered when penicillin treatment was stopped.

The cultures in these cases showed only staphylococci and streptococci. There were no pneumococci or influenza bacilli reported, although cultures were taken on blood agar. This suggests the possibility of laboratory errors.

The cured cases were in a mixed group, as far as cultures were concerned. Some showed negative cultures, and several of those showing hemolytic Staph. aureus were not cured. Spontaneous cures must be considered.

Herpetic keratitis developed in two cases during penicillin therapy.

SUMMARY AND CONCLUSIONS

The results of treatment of 55 cases of conjunctival and eyelid infections with penicillin were tabulated.

Allergic dermatitis was noted in 16 percent of the cases.

The results for the group as a whole were not superior to those shown by other forms of therapy. In a few individual cases, however, the results were remarkable.

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SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

April 1, 1946

DR. MAURICE L. WIESELTHIER, *presiding*

This meeting, the annual round-table discussion, was devoted to a single subject, "Complications of Ocular Surgery." Questions submitted before the meeting were edited and divided among the following ophthalmologists who comprised the panel of experts: Dr. Conrad Berens, Dr. Paul A. Chandler, Dr. John H. Dunnington, and Dr. Daniel B. Kirby. The interrogator was Dr. Isadore Givner.

PROPHYLAXIS AND THERAPEUSIS OF WOUND INFECTION

DR. CONRAD BERENS. The postoperative cataract wound may be infected from the air, conjunctiva, instruments, hands, or upper respiratory tract of the surgeon, assistants, and observers. The use of 1-percent silver nitrate preoperatively showed, in a study of 1,000 cataract extractions, suppuration in only one case. It is probably too early to say whether penicillin or sulfathiazole ointments are more efficacious than silver nitrate instilled two hours preoperatively, plus 25-percent argyrol at operation.

Conjunctival smears and cultures are taken a week before operation and, if pathogens are found, appropriate treatment is instituted. Lacrimal-sac infection should be treated, or dacryocystectomy or dacryocystorhinostomy performed. If infection persists, the puncta should be obliterated before operating. When bacteria are present in the eye and nose, they are often of the same type and toxicity. Nasal and nasopharyngeal cultures have indicated unsuspected sinusitis. The conjunctiva may be secondarily infected from the nose and sinuses.

The surgeon and others in the operating room wear masks covering the nose and mouth. Thin rubber gloves minimize infection from the surgeon's hands. A narrow, complete conjunctival flap, carefully sutured, is most important in preventing infection. Instruments are preferably dry sterilized. Some surgeons immerse them in boiling water before introduction into the anterior chamber. A further precaution is to place instruments, sutures, and certain dressings in a 1:3,000 aqueous solution of zephiran.

Penicillin and sulfa drugs pre- and postoperatively seem to prevent certain low-grade postoperative infections, and the benefits resulting from their use as prophylactics outweigh their disadvantages.

If the anterior chamber becomes infected, wash it out immediately with penicillin. Administer penicillin intravenously in addition to appropriate sulfonamide and foreign-protein therapy. Penicillin should also be applied in conjunctival packs and by iontophoresis. Inject penicillin into the vitreous if it becomes infected by pneumococci or staphylococci. If a coliform organism is the offender, streptomycin is injected intramuscularly and perhaps locally.

TREATMENT OF EARLY POSTOPERATIVE INTRAOCULAR INFECTION

DR. JOHN H. DUNNINGTON. Most postoperative infections are due to staphylococcus aureus. Very little of any antibiotic agent applied locally, either in solution or ointment, penetrates into the

cornea and practically none into the aqueous. For effective penicillin treatment more energetic methods must be employed: (1) The eyecup, described by Struble and Bellows, through which solution can be introduced, should be applied for 30 minutes four times a day. (2) A cotton pledget saturated with penicillin (10,000 units per c.c.) should be placed in the cul-de-sac for an hour. (3) Subconjunctival injections of penicillin (2,500 units per c.c.) in novocaine or following novocaine injection give some bacteriostatic action to the aqueous. (4) Iontophoretic application of penicillin (2,500 units per c.c.) for two minutes gives the highest aqueous concentration of any of these methods. Usually 20,000 units of penicillin is also given systematically every three hours, combined with sulfadiazine, although very little of this penetrates into the ocular structures. Foreign-protein therapy probably enhances the effect of these treatments. Dr. Dunnington prefers these methods to direct injection into the anterior chamber. Vitreous injections, reserved for definite posterior infections, are not classified as early infection.

Vitreous presentation or loss in cataract extraction

Dr. Daniel B. Kirby. Presumably all precautions have been taken to avoid this complication. The loss of fluid vitreous offers less of a technical problem than normal or viscid vitreous because the eye will heal more gracefully if the cataract is extracted in capsule without undue trauma. Extracapsular extraction is difficult because the hypotony renders pressure ineffective and contraindicated because these eyes react badly to cortical remnants. Intracapsular extraction is feasible by traction, rotation, and if need be, stripping of the zonule. Accurate closure with appositional corneoscleral sutures is important. A bubble of air or saline may replace some of the intraocular fluid.

Viscid or normal gel vitreous is more important and dangerous. If the vitreous is in the anterior chamber or in front of the lens, loop extraction is indicated because the vitreous interferes with placement of the forceps or suction cup. Place the loop carefully behind the lens to minimize vitreous loss and prevent dislodging the lens into the vitreous by other manipulation. If the vitreous is alongside the lens, forceps or suction cup may be employed. A wide iridectomy lessens the usual drawing up of the iris.

Prolapse or loss of viscid vitreous after the extraction is less serious when the intracapsular, rather than the extracapsular, method is used. Pressure is removed and the eye closed for several minutes; then cut away protruding vitreous and close accurately with corneoscleral sutures. If an iridectomy is possible and has not yet been done, do it, reposit the pillars, inject air or saline, and raise the head to help prevent iris incarceration. This careful toilet may salvage the eye; whereas, hurried backing out invites infection and poor healing with other complications.

Treatment for a flat anterior chamber with separation of the choroid

Dr. Paul A. Chandler. Since corneoscleral sutures have been used, this has been a rare complication after cataract extraction. If it occurs and the anterior chamber is flat for an extended period, there is potential danger from peripheral anterior synechiae and glaucoma. Therefore, watchful waiting should not be employed too long, and interference is probably advisable during the second postoperative week. In two cases, the anterior chamber had been filled with air through a small puncture over the iris. When the

air was absorbed, the anterior chamber remained formed and the separated choroid had disappeared. This discussion applies, of course, only to cases without an obvious leak.

Selection of the filtration operation will to some extent avoid flat chamber. In older patients with a very thin, friable conjunctiva, there is greater likelihood of the anterior chamber remaining flat after a trephining operation than after iris inclusion. Dr. Chandler has not seen this complication persist more than a week after iris inclusion. It is safe to permit the anterior chamber to remain flat for a long period after trephination if there is free filtration. If filtration becomes less or disappears, the anterior chamber should not be permitted to remain flat too long. He has interfered in only two of these cases. In one, after a month, a sclerotomy over the separated choroid was performed with a cataract knife. The anterior chamber formed while the patient was on the operating table and in 3 to 4 days the choroid was back in place. In the other, after a similar sclerotomy, the anterior chamber was formed at once, but the choroid did not go back. If there is not free filtration, Dr. Chandler is inclined to do such a sclerotomy early, for it is safe and simple.

Attempted intracapsular extraction through a round pupil when the capsule ruptures

Dr. Daniel B. Kirby. The fragility of the capsule varies. If the forceps slip off without rupturing it, the area of application has been weakened and the next grasp should be elsewhere. A small tear can be straddled with the forceps. In larger tears above, Dr. Kirby has applied the forceps near the lower pole, tumbling the lens out in capsule. He has also slipped a second pair of intracapsular forceps held in the right hand over the torn edge of the capsule and, with alternate traction on both forceps, removed the capsule and its contents.

If the capsule edges are not easily visible with the loupe and if the lens is less than half out, use toothed forceps, remove a large piece of capsule and perform a capsulotomy extraction.

It may be possible and desirable to remove the loose capsule after the cortex and nucleus are out. The capsule may be grasped with intracapsular forceps, drawn out a little, grasped below with other forceps, and so be gradually removed even when sufficiently fragile so that one forceps used alone would tear it. In some cases with relaxed vitreous, it is justifiable to lift the corneal flap and pick up the loose capsule.

If the posterior capsule is intact, it is feasible to irrigate away loose cortex. After all the capsule has been removed, the conservative closure of such eyes without risky manipulation is justified in order to prevent injury to the hyaloid and vitreous prolapse. Complete iridectomy depends on whether the lens cortex and nucleus are easily delivered without a coloboma. Postoperatively a round pupil is the more desirable, but the reaction of the eye may be less with an iridectomy.

Iris prolapse and its treatment after cataract extraction

Dr. John H. Dunnington. The incidence of this complication is reduced by careful wound closure. If it occurs, the general rule should be prompt excision. If more than 12 hours elapse after its appearance, a freeing of the iris is difficult. Dr. Dunnington has not had success with replacing the iris without excision, nor have such cauterizing agents as trichloracetic acid been successful. The only condition in which a decision between noninterference and excision may be difficult is when there is a small pro-

lapse completely covered by conjunctiva. He believes these should be excised as they have a tendency to enlarge. If the patient is too tense or the eye too tender for local anesthesia, pentothal sodium is very satisfactory. There is no material difference in the management regardless of the time of its appearance.

Complications attributable to keeping patients abed postoperatively

Dr. Conrad Berens. Two patients developed hypostatic pneumonia after cataract extraction, probably the result of a long stay in bed. Severe constipation and gastro-intestinal disturbances have been common, but they can usually be controlled by colonic therapy if the usual methods for relief fail. Long bed rest with both eyes covered induces severe psychic disturbances in some patients. Nervous patients should have the unoperated eye opened the day of the cataract extraction and in 2 or 3 days following operations for detachment of the retina. The patient is propped up 30 degrees as soon as possible after operation for cataract, glaucoma, and detachment of the retina if the detachment is below. If the detachment is above, the patient is kept flat. If the cataract wound is sutured sufficiently well, Dr. Berens has permitted patients out of bed the same day, although the sedation and nerve shock make it preferable to wait until the next day. Only detachment patients are not permitted out of bed on the same or first postoperative day. They are usually kept in bed for two weeks, although certain experiences have made him question this practice. The first patient he operated on in 1930 after returning from Gonin's clinic sat up in a chair after five days because the operation seemed a failure, but later there was a complete reattachment. Two of his most unruly and restless patients have had satisfactory results.

Operation for chronic simple glaucoma complicated by cataract

Dr. Paul A. Chandler. One must decide in each case whether the cataract or the glaucoma is primary. If the glaucoma is serious and the cataract not advanced, the operation is chosen on the same basis as if there was no cataract. In patients past the middle sixties, the glaucoma is very often secondary to cataract, particularly if the anterior chamber is shallow. If the cataract is nearly mature to hypermature and if the tension can be brought to reasonable limits with miotics, Dr. Chandler prefers intracapsular extraction with a broad basal iridectomy. He hesitates to do a glaucoma operation to be followed shortly after by lens extraction in these cases. The lens can be extracted successfully, but occasionally, despite careful placement of the cataract section so as not to disturb the filtering scar, it will cease to function after cataract operation.

Lens subluxation or dislocation into the vitreous after a cataract incision

Dr. Daniel B. Kirby. A distinction must be made between cases with fluid and viscid vitreous. If preliminary examination discloses subluxation and fluid or semifluid vitreous when the section is made, the vitreous will seep away and the lens will sink. It is safe to place sclerocorneal sutures after the section. Outside pressure is ineffective, and the lens should be removed by traction with forceps. When the lens subluxates upward, Dr. Kirby recommends passing a loop down over the face of the lens and rotating it in its long axis through the break in the zonule to come up under the lens. The loop supports the lens while intracapsular forceps are placed on the capsule to draw the lens down and hold it while the loop is maneuvered to strip off the remaining zonule if necessary. The typical passage

of the loop through the upper intact zonule would risk luxation of the lens into the fluid vitreous.

If, before or during the operation, the lens is found luxated completely into fluid vitreous, then Verhoeff's technique of irrigation of the vitreous chamber, floating the lens to lift it out with a loop, appears useful. A lens adherent to the retina or ciliary body is best left alone as the eye will better tolerate the condition than the interference. Try coaxing the lens through a dilated pupil by the prone position, and then imprison it with a miotic for immediate removal.

With viscid vitreous, use preplaced sutures. If the intraocular pressure is increased, posterior drainage of the vitreous to relieve the pressure may give fewer complications than uncontrolled loss of vitreous anteriorly. A complete iridectomy minimizes updrawing of the pupil. After the aqueous escapes, the vitreous comes forward and brings the lens forward with it. The loop is passed through the zonular hiatus and a trial of traction alone is made. Pressure on the cornea is seldom necessary. Forceps support the lens while the loop strips off the zonule, sweeping around the equator where the zonule is adherent. In some cases, forceps cannot be placed on the capsule because of overlying vitreous.

A lens luxated into viscid vitreous is best visualized with ultraviolet light and its mobility tested by moving the patient. The interference and resistance of the vitreous makes it unlikely that it can be brought into the anterior chamber. If the lens remains in the viscid vitreous, it will cause degeneration and fluidification and its removal is simpler, although the prognosis is grave.

Delayed restoration of the anterior chamber

Dr. John H. Dunnington. Prophylactic treatment of delayed restoration of the anterior chamber consists of accurate wound closure plus careful wound toilet. In round pupil extraction, the iris may be a causing factor, and eserine may possibly be a help as a postoperative measure. The corneoscleral suture is valuable if properly applied, but otherwise it is worse than none. The introduction of air after cataract extraction has lessened the incidence of this complication. Absence of the anterior chamber means a leaking wound calling for location and closure of the leak. A conjunctival flap generally is insufficient to close the wound. In addition, place a suture through the lips of the opening to approximate the edges. Any epithelium about the opening should be cauterized before placing the sutures.

Complications following delayed restoration of the anterior chamber are: (1) detachment of the choroid; (2) total or partial peripheral synechia; (3) adherence of the iris to the face of the vitreous; (4) there may develop adhesion between vitreous and cornea producing deep corneal opacity; (5) if the delayed restoration has followed a glaucoma operation, cataract may follow; (6) formation of a vascular membrane on the posterior surface of the cornea; (7) epithelialization of the anterior chamber; (8) glaucoma.

Hypotony after a filtering operation

Dr. Paul A. Chandler. Two points especially have a bearing: (1) A very thin conjunctiva. (2) The absence of postoperative inflammation. If, at operation, manipulation of the conjunctiva shows it is thick and strong, hypotony will seldom develop. With a very thin and delicate conjunctiva, and this is especially true of older people, it is easy to get filtration; and if a 2-mm. trephining operation is done, a soft eye will often follow. Therefore, iris inclusion, rather than trephination, is the operation of choice in older individuals with thin conjunctivas. The softest eyes are those which remain white

and quiet postoperatively. If the postoperative reaction of an eye could be predicted, one would perform an operation giving freer filtration, such as a trephination, where a stormy convalescence is anticipated; and a less extensive procedure, as iris inclusion, for little postoperative reaction. If during preparation for operation and the operation itself, the eye becomes more or less congested, one would expect a greater postoperative reaction and vice versa, but Dr. Chandler is not sure whether this is a reliable test.

For obvious leakage of the bleb, a conjunctival flap is drawn down over the opening after cauterizing the cornea around the bleb. Cauterization of the surface of the bleb may have no effect in some cases; while in other cases, if more extensive, may entirely stop filtration. Where there is no obvious leak, Dr. Chandler uses only a mild antiseptic to ward off infection. In younger patients with very soft eyes after filtering operations, one is at least sure the glaucoma is arrested. Often, after a year or two, the tension rises to reasonable levels. Posthypotony cataract can be removed with less likelihood of recurrence of the glaucoma than if the filtration were barely adequate before extraction of the lens.

Reoperation after an unsuccessful or inadequate muscle operation

Dr. Conrad Berens. This depends upon the type of operation and what it was designed to correct, the patient's age and health, and many other conditions. Specifically, if a patient has had an operation upon one lateral rectus in exotropia at 6 meters with little convergence insufficiency, he may have an operation within a month on the other eye for residual exotropia of 10 degrees or more. In divergence insufficiency with a resection of one lateral rectus muscle, resect the other lateral rectus after a month. If both lateral recti had been operated upon, wait four months before reoperating. In convergence insufficiency after operating on one medial rectus, should there be a high residual deviation at the near point, do not hesitate to operate within two months on the other medial rectus unless the patient responds unusually well to convergence exercises. However, in convergence insufficiency any indicated general treatment and converging exercises should be given a thorough trial before operation. In convergence excess, especially in young children, wait three or four months after a recession on one medial rectus before operating on the other medial rectus. If both medial recti had been operated upon, wait six months before operating. In hypertropia due to weakness of one superior rectus with overaction of the inferior oblique of the other eye, if a marked hypertropia persists despite an operation on the inferior oblique, after two months consider resecting the weak superior rectus. If the patient fixes with the eye with the paretic superior rectus, vertical deviations caused by spasm of an inferior oblique tend to increase. If the vertical deviation is not stabilized, consider myotomy at the orbital insertion. Secondary cicatricial divergent strabismus after retroplacement or recession of a medial rectus is corrected by resection, advancement, and Tenon's capsule transplantation of the involved muscle after at least three months.

Choroidal detachment after intraocular surgery

Dr. Conrad Berens. Detachments of the choroid following cataract extraction may occur at or immediately after operation. Dr. Berens has never operated for this type of detachment which O'Brien says occurs after practically every cataract extraction. An almost complete choroidal detachment after a glaucoma operation subsided rapidly leaving no observable ophthalmoscopic signs. If the wound heals

completely or filtration diminishes rapidly, the detachment usually heals spontaneously and requires no special treatment. These patients are permitted to be up as soon as any cataract patient. With postoperative detachment persisting longer than six weeks, consider an electrolysis puncture or a simple scleral puncture. Delayed detachments occurring months or years later may be caused by reopening of the wound or possibly by lowered intraocular pressure from other causes.

When a filtering wound has leaked as shown by fluorescein and application of trichloracetic acid has not proved effective, Tenon's capsule has been successfully transplanted under the conjunctiva.

Handling of expulsive hemorrhage

Dr. Daniel B. Kirby. Know the patient's cardio-vascular system before operation. If the systolic pressure is high, sedation and rest in bed preliminary to operation are good. If the patient is plethoric, venesection may help. If the diastolic pressure is 120 mm. Hg., there is apt to be turgescence of the choroid, presentation of vitreous, if not intraocular hemorrhage and expulsive hemorrhage. The whole mechanism also depends on how the blood vessels withstand the blood pressure and the lowering of the intraocular pressure by the incision.

Inject crude liver if the red blood cells are not normal; inject ascorbic acid, in addition to prescribing fruit juice by mouth, for its effect on the blood vessels. The patients need milk or calcium. The bleeding and coagulation time does not indicate the degree of bleeding at the time of surgery. Inject vitamin K for abnormal platelet count or prothrombin time, using care in elderly patients who may develop a thrombosis, if the action is too great, and in the patient predisposed to thrombosis.

It is best to postpone surgery for serious orbital hemorrhage after retrobulbar injection. If expulsive hemorrhage occurs once the section has been made, put on pressure and trust the hemorrhage will stop. All one can do is to explain the situation and advise enucleation as soon as feasible.

Postoperative hyphemia and intraocular hemorrhage

Dr. John H. Dunnington. Treatment for postoperative hyphemia is simple: bed rest, eye rest, watchful waiting, and no heat. If the tension is increased or the anterior chamber is filled with black blood showing no tendency to absorb, a paracentesis for removal of the blood clot is in order.

Proper placing of the incision is most important in controlling intraocular hemorrhage. A deep section is the usual cause of blood filling the anterior chamber. Should such an occurrence take place, wait until bleeding is stopped, remove the clot, and then proceed with the extraction. In a patient with high ocular tension, try to avoid sudden reduction of pressure by retrobulbar injection. If tension remains high, reduce it by very slow evacuation of the anterior chamber. Arterial tension does not seem to have anything to do with hemorrhage at the time of operation. If the iris is vascularized and the cataract is complicated, select the site of the iridectomy carefully to avoid blood vessels. If bleeding occurs at time of operation, wait until a clot forms before performing the extraction.

Reoperation in acute and chronic simple glaucoma

Dr. Paul A. Chandler. One may rarely see a case in which, a few hours after operation for acute glaucoma, the tension rises to an exceedingly high level, and something has to be done immediately. If operation for acute glaucoma fails to bring the tension to normal, there is usually no great urgency in doing the

second operation. It is best to wait until the eye becomes quiet or shows no further tendency toward becoming quiet. If the pressure is 30 to 39 mm. Hg., continue with miotics. Unless the field is exceptionally small or the tension is so high as to constitute a real danger, one can safely wait weeks before reoperating. If the tension is over 40 mm. Hg., one dare not wait long, as damage takes place more rapidly at these levels. In chronic simple glaucoma, follow somewhat the same rule. A guide is whether the patient can afford to sacrifice a little more vision and field while waiting for optimum conditions for reoperation. Chances for success in a second operation are better with a quiet eye, but if congestion persists there is no point in further delay.

Many of the reasons for failure of glaucoma operations are unknown, but one reason lies in the choice of operation. Iridectomy will not be sufficient in neglected primary acute glaucoma which does not respond to miotics. A filtering operation is required for this. Failures in chronic simple glaucoma may be due to errors in technique. In a trephining operation, if the trephine is slanted too much and less than two thirds of the corneoscleral button is loose when the anterior chamber is entered, it is difficult to remove the whole button with scissors. Once the trephine is applied accurately it should not be removed until it enters the anterior chamber. One may occasionally push the button into the anterior chamber, but no harm is done. A dull trephine blade adds greatly to the difficulties. In iris inclusion operations, a cause of failure is too much manipulation of the iris. The grasp of the iris must be gentle and not too wide, withdrawal should be very slow, and undue traction should be avoided. The cut should be made with very sharp scissors. Once the cuts are made, release the iris forceps immediately, and the operation is over. Even though the iris is rolled up make no further manipulations. One of the greatest reasons for failure in all glaucoma operations, no matter how well executed, is marked postoperative inflammation. An eye remaining irritable with postoperative iritis for many weeks is very apt not to show good filtration. This is a real traumatic iritis. If a second operation is performed, everything possible should be done to eliminate foci of infection which might be factors in causing the iritis.

Glaucoma following cataract extraction

Dr. Conrad Berens. If the glaucoma is caused by delayed reformation of the anterior chamber, it is justifiable to inject saline or air in an attempt to open the closure which causes difficulty. If the hypertension is caused by inflammation, Dr. Berens often injects typhoid-H. antigen intravenously, followed in 48 hours by aspiration of the anterior chamber. He frequently uses mild mydriatics and applies heat. Foci of infection are removed or resistance to them raised by vaccine therapy combined with penicillin, the sulfonamides, or other appropriate measures. If the hypertension is not marked or painful, he often aspirates. One patient's anterior chamber was aspirated 16 times before the tension was stabilized. In this patient, no chronic infection or other specific cause was found. Marked pain is sometimes relieved by injecting procaine and then alcohol through the same needle into the ciliary ganglion. If aspiration, washing out soft lens matter from the anterior chamber, repeated paracentesis, and local measures do not relieve the situation, the first choice of operation is cyclodialysis. In recent years, cyclodiathermy, or cyclo-electrolysis, has given excellent results, although in three cases the procedure had to be repeated below. If these measures do not succeed, Dr.

Berens usually incarcerates one pillar by performing a sclerectomy over one pillar subconjunctivally with a punch. If this does not stabilize tension, the other pillar is incarcerated. The final measure, which has been successful in some cases, is to perform a small trephining operation below.

Glaucoma appearing after cataract extraction

Dr. Paul A. Chandler. Glaucoma appearing for the first time after extracapsular or linear extraction is not uncommon in cases in which a good deal of cortex is left. No treatment is required as long as the tension stays between 30 to 35 mm. Hg. If tension is higher and there is a large amount of cortex, it is probably best to remove some of the cortex. If there is very little cortical material, or if the extraction was intracapsular, then do nothing for the glaucoma, because in these cases the tension is usually transient and harmless. Much worry about glaucoma in the immediate postoperative period after intracapsular extraction can be avoided if the tension is not measured. When, three days after intracapsular extraction, a patient showed a hazy cornea and increased tension, nothing was done, and in two days the tension was normal. In a case in which there is marked increase in tension in the immediate postoperative period, a simple paracentesis would be the most drastic measure considered. For a theoretical choroidal hemorrhage which does not break the wound open but results in an exceedingly hard eye, one might do a scleral puncture over the area of the detached choroid.

Grasping the lens capsule for an intracapsular extraction

Dr. Daniel B. Kirby. Grasping the capsule below the pupillary border is well illustrated in the Knapp operation in which the zonule is ruptured by traction, and rotation and tumbling are started before pressure is applied. If the lower zonule always ruptured easily, this would be the best place for forceps application, but experience has shown that it is probably a better procedure to apply pressure simultaneously. The lack of transparency of the collapsed cornea is not too much of a handicap in placement of the forceps. The round pupil can be well preserved by this method. However, the degree of rotation and traction and the ability to lift the lower pole of the lens are limited by the relatively narrow and shallow anterior chamber. If forceps are not introduced carefully, the corneal endothelium may be injured. Lastly, it is not necessary to tumble all cataracts to protect the vitreous which, if properly handled, does not need protection. Vitreous loss is due to factors other than the method of delivery.

Dr. Kirby grasps the capsule above because it is more easily accessible, being directly visible when the corneal flap is elevated. This method gives the surgeon better control over his grasp of the capsule. Simultaneous pressure from below tilts the lens and permits straddling of the presenting adventitious equator. The round pupil can thus be preserved. There is greater possibility of traction and rotation with appreciation of the correct position for simultaneous pressure for greatest effect. The zonule may be seen during these maneuvers and its qualities assayed. If it is too resistant, then a dehiscence may be started by touching it at the point where it is put under tension and with such a hole begun in the zonule, tearing may be continued by traction and rotation, or the remainder of the zonule may be stripped off.

Reoperation for retinal detachment

Dr. John H. Dunnington. If the operation is not 100 percent successful, it

is not successful. A second operation for retinal detachment generally is not done in less than 3 to 4 weeks. If ocular tension is low and retinal detachment is not progressive, it is preferable to wait longer. On the other hand, if there is detachment with a hole not closed completely at the time of the first operation, do not delay unnecessarily. Wait only 3 to 4 weeks before going ahead with the second operation. The chances of success go down with each operation, although in one case success was achieved after four previous failures. Success resulted in 3 of 9 cases operated three times. In one patient, a successful operation was performed on her only eye after five previous operations. The condition of the eye, the extent of the detachment, and the tension of the eyeball should be the factors which determine whether to reoperate, rather than the number of previous operations.

Glaucoma operations for Negroes

Dr. Conard Berens. The only operation with which Dr. Berens has had extensive experience is iridocorneosclerectomy. These wounds do not filter well and hypertension often recurs, even when combined with iridencleisis. He has used cyclodiathermy successfully several times. Cyclo-electrolysis has been used once, but the time since operation has been too short to judge the results.

Hyphemia after glaucoma operations

The head and torso are kept elevated. In the early stages, cold compresses are applied, later these are followed by hot compresses, if tension is controlled. The anterior chamber is not irrigated, and Dr. Berens has not seen serious permanent complications. If the blood extends under the conjunctiva or is under pressure, irrigation of the anterior chamber might be advisable. Nothing used preoperatively or postoperatively has seemed to aid in preventing hyphemia. If bleeding from the sclera or episcleral blood vessels persists at the time of operation, the actual cautery or electrodessication is applied. This type of hyphemia is not recurrent. In this respect it differs from the hyphemia which follows cataract extraction. In both types of hyphemia, the bleeding seems to be more from the sclera than from the iris.

Leon H. Ehrlich,
Secretary.

COLORADO OPHTHALMOLOGICAL SOCIETY

April 20, 1946

Dr. George Stine, *presiding*

Tumor of ciliary body

Dr. William M. Bane presented a man, aged 38 years, in whom, during a routine refraction, a symptomless, brown-gray spherical tumor of the ciliary body was found. It measured about 5 mm. in diameter and was attached at the 4- to the 6-o'clock position. It was easily seen through the dilated pupil, and its outline was well-shown by transillumination.

Ophthalmic surgery

As part of the annual Edward Jackson Memorial Lecture, Dr. Lawrence T. Post of St. Louis delivered an address on ophthalmic surgery in which he discussed the various details of surgical techniques used in his own work at Barnes Hospital in St. Louis. In cataract extractions, a preliminary complete physical examination including X-ray studies of teeth is insisted upon. If the blood pressure is above 200, every effort is made to reduce it, even to keeping the patient hospitalized for days or weeks before surgery. Each instrument used is dipped in zephiran

(1:3,500) solution before touching the eye. A 2-mm. conjunctival flap is dissected down 1 mm. beyond the limbus. One McLean suture and two conjunctival sutures are inserted. A small section is made within the corneal tissue and this is enlarged with scissors. Peripheral iridectomy and intracapsular extraction are usually employed. Penicillin ointment is routinely used in the conjunctival sac. At one time vitamin K was used before and after surgery but this was discontinued since it seems to have no real effect on hemorrhage.

In retinal-detachment cases, the patient is kept in bed several days before surgery so as to place the detached retina in the flattest position possible. If no tear is seen, the most prominent part of the detachment is kept lowest. At operation, as much of the subretinal fluid as possible is drained off by syringe. After operation, the patient remains in bed for three weeks and wears pinhole spectacles for three months. If the retina has been separated for as long as one month, or if the patient has one good eye remaining, operation is in most instances not advisable, since the chances for reattachment are reduced to less than 25 percent.

After cataract and strabismus operations, the most frequent surgical cases are those involving glaucoma. A particular problem in St. Louis is the care of chronic simple glaucoma in the Negro. After much trial and error, iridencleisis has become the most favored operation. Since its outcome seems to be entirely unpredictable, multiple diathermy puncture is used only after all other operations have failed. In the surgery of primary glaucoma, little place has been found for cyclodialysis, although in secondary glaucoma it has been used very effectively. In order to avoid postoperative hemorrhage after trephining, it has been found advisable to touch the bleeding points on the scleral rim with the actual cautery. Since doing this, little trouble has been experienced with this complication, which previously had been very disturbing.

The selection of cases for corneal transplantation must be very carefully made. A clear area of cornea must surround the opacity. Removal of the donor cornea is done at the time of transplantation.

Ptosis cases are divided into three groups: (1) Partial ptosis due to levator weakness. For this, a tuck is made in the levator tendon through a skin incision. (2) Complete absence of levator action. For this, a sling of fascia lata is carried around the superior rectus and is attached at each end to the edge of the tarsus. (3) No action of the superior rectus. For this, three fascia-lata strips are attached between the tarsus and the frontalis through an incision in the eyebrow.

Discussion. Dr. Ralph W. Danielson asked what sutures were used in muscle surgery and what was the maximum amount of resection. Dr. Maurice Marcove asked if overcorrection was ever done in divergent squint. Dr. William M. Bane asked about the comparative results of surface diathermy and diathermy puncture in glaucoma. Dr. W. H. Crisp asked whether Dr. Post still used the thermaphore in detachments.

Dr. Post, in closing, said that he used all sutures in muscle work except the O'Connor cinch. He particularly liked the tuck in phoria which was passing into tropia. The maximum resection was 7 mm. Overcorrection was not done for divergence. Diathermy puncture was rarely used because of the tendency of the ciliary body to atrophy. Use of the thermaphore had been discontinued because of some tendency to destructive hemorrhage.

Morris Kaplan,
Secretary.

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RESEARCH STUDY CLUB

The 16th annual midwinter course of the Research Study Club was held in Los Angeles, January 20 to January 31, 1947. For the Eye Section, the principal guest speakers were Dr. William L. Benedict and Dr. Henry P. Wagener of the Ophthalmological Department of the Mayo Clinic. Their courses were augmented by the presentations of Dr. Cecil O'Brien of the University of Iowa, Dr. Dohrmann Pischel of Stanford University, Dr. David Harrington of the University of California, Dr. Kenneth Swan of the University of Oregon, and Dr. Meyer Wiener of Coronado.

There were more than 400 persons in attendance at the course; members came from all parts of the United States, and from as far away as Bagdad, Iraq. Dr. A. Ray Irvine, chairman of the program committee, and Dr. Harold Whalman, secretary, deserve much credit for having ing brought together these outstanding

authorities. Never before has the Research Study Club had such an array of teaching talent, and the full attendance at every lecture and instruction course was a tribute of appreciation to the teaching staff.

Dr. Benedict gave a masterful treatise on diseases of the orbit. Of particular interest was Dr. Benedict's discussion of X-ray therapy for various conditions causing exophthalmos. He showed slides and moving pictures of cases of exophthalmos brought about by certain nonmalignant diseases of the orbit—Mikulicz's disease, lymphosarcoma, low-grade cellulitis, and special cases of exophthalmic goiter—which had responded successfully to X-ray therapy. The early treatment of malignant exophthalmos related to thyroid-pituitary imbalance, by using X rays on the globe, was particularly new. This treatment has met with fair success if instituted during the period of infiltration, before fibrous changes set in.

Dr. Wagener discussed retinal changes in relation to systemic disease. Sclerosis of retinal vessels is more an indication of the duration of hypertensive disease than of its severity; whereas, localized spastic constrictions are, in general, indicative of the severity. Exudative lesions depend on the degree of anoxemia, with subsequent edema and degeneration, as well as on the lack of absorption of end products. Thrombosis of a branch of a vein usually indicates a mild hypertension with chronic sclerosis of the vessel, and, from the standpoint of hypertension, the prognosis is good. The prognosis for vision is more favorable if there is early recanalization of the vessel. In certain of these cases the anticoagulants are indicated, particularly if the superior temporal vessel of an only eye is involved. Hemorrhages, edema, "cotton-wool" patches, appearing in the course of hypertension, signify beginning retinal-vascular decompensation.

The picture in glomerular nephritis is one of anemia with, in addition, vascular disease as sclerosis or spasm, the anemia being a distinguishing feature. In patients who have only a slight increase in blood pressure, albuminuria, and arteriolar sclerosis, as judged by the appearance of the retinal vessels, the condition is probably one of essential hypertension and not nephritis in about 90 percent of cases. A large percentage of nephritics show no sclerosis.

Speaking of toxic pregnancy, Dr. Wagener said that there is generalized and localized spasm of the retinal vessels. If this is not rapidly corrected by sedatives, the pregnancy should be terminated to avoid the onset of sclerosis which is irreversible. If one waits until retinopathy develops, the chance of obtaining a viable baby is extremely poor, and the chance of developing marked arteriosclerosis is great.

For Eale's disease Wagener believes that bedrest is the most important part of the treatment. Discussing temporal arteritis, he stated that the vision of 50 percent of all patients with this affection eventually becomes involved. Optic neuritis and occlusion of the central retinal artery are common complications. Recurrent spasms of the central artery or of branch arterioles may be allied to Raynaud's disease. It is probable that angioid streaks in the choroid are an expression of a generalized defect of elastic tissue in the blood vessels, as well as in the skin.

In diabetic retinopathy, Wagener feels that the early stages can be stopped or reversed if a careful diabetic regimen is instituted. He has seen "cotton-wool" patches disappear in diabetics after the clearing of an infection, such as carbuncle. The serum protein may be low in diabetes, the albumin-globulin ratio altered, and the blood cholesterol high. Retinal hemorrhages are less if these ab-

normal blood findings are corrected. X-ray therapy may promote absorption of blood from the vitreous, but has no effect on the proliferation of vessels.

The retinal hemorrhages in blood dyscrasias are a result of thrombocytopenia—not of hypoprothrombinemia (vitamin-K deficiency)—plus toxic damage to the capillary endothelium and venous stasis. The hemorrhage is usually massive and dense with white centers in leukemias. Spot hemorrhages that have white centers and regular borders are more characteristic of bacterial endocarditis; and those with irregular white centers and irregular borders more characteristic of blood dyscrasias.

Dr. Meyer Wiener gave a course in applied anatomy in eye surgery, in which he correlated many of the surgical tricks he has originated with the anatomy of the part involved. The course was fascinating because of the practical application Dr. Wiener has made of what might otherwise be abstract anatomic facts. In addition, he gave a lecture on his work with rehabilitation of the blind, outlining ways and means whereby these patients may be helped to live happy and useful lives.

In discussing cataract surgery, Dr. O'Brien stressed the value of the keratome incision; the importance of marking the limbus at the 12-o'clock position before starting the operation in order to orientate the position of the globe; the value of having the assistant apply counter pressure, above, on the scleral lip of the wound, as the lens is being tumbled; and the importance of having, in so far as possible, direct visualization of the lens as it is being grasped below with the forceps. He is able to observe the lens, as it is grasped, by elevating the flap with a suture which has a knot in one end to keep it from pulling through.

Dr. O'Brien also showed excellent slides and discussed both the history and course of various types of ocular tumors.

Dr. Pischel discussed in great detail the diagnosis and treatment of retinal detachments. He stressed not only the importance of the patient's history but also the significance of the patient having noticed sudden showers of specks before the eyes, flashes of light, and a curtain effect blotting out part of the visual field. He said that he sometimes spends many hours searching for holes and that often these can be found only with maximum dilation of the pupil and with a brilliant, narrow, ophthalmoscopic beam shone to one side of the hole, so that it stands out by retroillumination. The position of the greatest degree of detachment does not necessarily indicate the position of the hole; since fluid gravitates down, the hole may be above. He favors the idea that most holes are the result of vitreous traction on the retina. In his studies of these cases with the Koeppe contact glass and the slitlamp, he has observed detachment of the vitreous with but a single point of attachment at the site of the tear.

Pischel feels that idiopathic detachments are frequently precipitated by minor jars or blows to the body that may be forgotten until recalled after searching questions and prolonged reflection on the part of the patient. Bumping the head, sitting down hard—such falls or jolts may be the precipitating factor in producing an idiopathic detachment. Approximately 25 percent of the patients suffering such detachments develop detachment in the other eye within five years, a fact stressing the importance of treatment of the original detachment.

There is no treatment other than surgery. Pischel advises preliminary immobilization of the eyes, in a position dependent upon the region of the detachment, to allow as much settling as possible before operation. The region of the tear is treated under direct ophthalmo-

scopic observation, using Pischel pins for localization and Pischel points for semi-perforating diathermy treatment. Dr. Pischel does not us galvanic current but has no objection to its use if combined with diathermy. He obtains about 80 percent cures in all detachments seen, and, in desperate cases, he does not hesitate to resort to Lindner's scleral shortening operation.

He feels that about 10 percent of detachments have a hole in the macular area that needs treating. If there is doubt about the presence of a hole, however, it is most likely absent, and the macular region need not be treated. Only in this respect do his ideas differ from those of the late Clifford Walker, who must be given credit for having practiced (many years before they were generally appreciated) the methods which today are considered the latest and best. Appreciation of this fact does not detract from credit due Pischel, whose work has been done independently and who popularized these concepts more than did Clifford Walker.

Dr. Harrington, in his discussion of tonometry, stressed the importance of taking tensions with two weights to determine the coefficient of rigidity of the cornea, as was advocated by Friedenwald. He feels that, in secondary glaucoma, rigidity of the corneoscleral coats of the eye is increased. This would account for an apparent increase in tension, which may not be real, and might explain the frequently observed fact that secondary glaucomas withstand tension better than primary glaucomas. Dr. Harrington is working on this problem and should soon have statistics important to an evaluation of this concept.

Dr. Swan, reporting on work for which a partial grant was given by the Research Study Club, discussed the use of new drugs in the treatment of external diseases. Apparently the Koch-Weeks, influenza, Morax-Axenfeld, pyocyaneous, and tuberculosis organisms are sensitive to streptomycin. However, these organisms become drug-resistant within a matter of a few hours. It is essential, therefore, that the initial dosage be maximal. For ocular conditions, systemic administration of 1 gm. a day, in addition to local application in the form of ointment (10,000 units per cc. for skin, and 5,000 per cc. for conjunctiva, every 2 or 3 hours); is used at present. The drug should be employed only in severe infections which fail to respond to other treatment, because 10 percent of the patients receiving streptomycin systemically develop irreversible damage to the eighth nerve. The earliest that damage has occurred in Swan's experience was after use of streptomycin for 16 days. Since most eye conditions respond in less time than this, he has not encountered deafness, resulting from the treatment with streptomycin, of any eye patient. Nevertheless, it is wise to depend primarily on local use of streptomycin whenever possible.

Regarding penicillin, in Swan's experience, 11 percent of the population became hypersensitive to penicillin after prolonged use, and so he advocates using it only in acute, not in chronic, processes. Penicillin can be very effectively introduced into the eye by iontophoresis, using 4-percent methocel in distilled water as the vehicle. Swan recommends a current of 1.5 milliamps for two minutes, the negative electrode being on the eye. This has been particularly effective for pneumococcus ulcers. By this method, the anterior chamber can be irrigated with penicillin, and penicillin can be injected into the vitreous if need be.

Swan feels that in those eye cases for which sulfonamides are indicated, for example in inclusion-body blenorrhea and trachoma, a blood concentration of 3 to 5 mg. percent is sufficient, and he recom-

mends sulfamerazine (2 gm. as an initial dose, and ½ gm. every 8 hours thereafter) to keep the blood concentration at the desired level. Sulfamerazine stays in the blood longer than sulfadiazine and penetrates the ocular tissues with more facility. Swan's experience with pyribenzamine, in controlling allergic conditions, has been favorable.

As usual, the California weather was sunny, the atmospheric radioactivity therefrom contributing to the physical well-being of the guests, while the local ophthalmologists extended hospitality and entertainment typical of Los Angeles and not available elsewhere.

S. Rodman Irvine.

WISDOM FROM THE PAST

One hundred years ago the first American edition of Lawrence's *A Treatise of the Diseases of the Eye*, edited by Isaac Hays, M.D., of the Wills's Hospital, Philadelphia, was published by Lea and Blanchard of Philadelphia. Lawrence's *Treatise* was first published in England in 1833, and a second edition appeared in 1840. It was an informative, mature study of diseases of the eye according to the knowledge of those days, and was very popular with the practitioners. It makes fascinating reading today, for it is filled with wisdom and timeless advice.

The following excerpt from the introduction by Lawrence is as timely today as it was 100 years ago and is reproduced here to express our philosophy of modern ophthalmology.

"It is hardly necessary to enlarge on the importance of the subject, or to prove formally that a knowledge of it is indispensable to medical practitioners. Everyone feels that sight is the most valuable of the senses; that it not only is, in itself, the most important inlet of knowledge, the most valuable medium of our communication with surrounding persons and objects, but also that it is essential to the full enjoyment of our other senses; to the free exercise of almost all our other faculties and endowments; so that these lose more than half their value when sight is gone. Hence blindness is one of the greatest calamities that can befall human nature, short of death; and some would perhaps prefer the termination of existence to its continuance in the solitary and dependent state, to which life is reduced by the privation of this precious sense.

"Loss of sight is the greatest misfortune even to the rich, who can alleviate it by purchasing the aid and services of others. How much more severely must it be felt by the poor, by the middle and lower classes of society, that is, by the great majority of mankind; who, being rendered incapable of labor, and having their minds uncultivated, find their existence reduced to a dreary blank, dark, solitary, and cheerless, burdensome to themselves and to those around them. Even our great poet, who might have been supposed to find every alleviation and resource that such an affliction admits of in his highly-gifted mind, and the exhaustless stores of knowledge with which it was furnished, repeatedly reverts to his blindness, and always in a tone of anguish and despondency characteristic of recent misfortune:

"Thus with the year
Seasons return; but not to me returns
Day, or the sweet approach of eve or morn,
Or sight of vernal bloom, or summer's rose,
Or flocks, or herds, or human face divine;
But cloud instead, and ever-during dark
Surround me from the cheerful ways of men
Cut off, and for the book of knowledge fair

Presented with a universal blank
Of Nature's works, to me expunged and rased,
And wisdom at one entrance quite shut out.'

"It often depends on the surgeon whether the patient shall retain or lose, recover or remain bereft of vision. Common external inflammation of the eye, if neglected or improperly treated, by rendering the transparent anterior portion of the organ more or less opaque, proportionally injures vision; inflammation of the iris, when unchecked, causes contraction of the pupil and effusion of lymph, which prevents the passage of light into the eye. Affection of the nervous structure, if not arrested in its beginning, terminates inevitably in diminution or loss of sight. Such distressing results have too often been promoted by modes of treatment, in favor of which the sanction of names that have enjoyed public confidence might be adduced. The success of operations for cataract, or artificial pupil, depends entirely on the knowledge, discrimination, and dexterity of the operator. The cases now alluded to are matters of daily occurrence, and make up the bulk of ophthalmic practice. The serious responsibility, which this view of the subject unfolds, will impel every conscientious practitioner to turn his anxious attention to the affections of this important organ, and to embrace all opportunities of acquiring that knowledge, which will enable him to act decisively and effectually on occasions of such momentous consequence.

"If there are any to whom the pleasure connected with the acquisition of knowledge, the satisfaction flowing from the consciousness of important duties rightly performed, and the gratitude so warmly expressed for the inestimable benefits of averting blindness or restoring sight should not prove an incentive sufficiently powerful to the study of ophthalmic medicine and surgery, their case must be deemed desperate; unless, indeed, their minds, insensible to higher feelings and nobler motives, should obey the impulse of self-interest and fear; unless they should be affected by the prospect of disgrace and injury, which ignorance and its inseparable blunders must entail. The consequences of wrong treatment cannot be concealed here, as in the obscure affections of internal organs; the visible changes of structure are obvious to external observation, and the unfortunate individual, whose sight is injured or destroyed by unskilful treatment, serves as a lasting memorial of the incapacity and rashness to which he owes his misfortune. The study of diseases of the eye is therefore now justly regarded as an essential part of general medical education; but it is more particularly so to country practitioners, who are thrown entirely on their own resources; who cannot, as in the metropolis, and some large cities, call in the aid of superior talent and knowledge.

"Although the importance of the subject must be admitted, it may be doubted whether the ophthalmic branch ought to be separated from the rest of medicine and surgery, as it must be, to a certain extent, by devoting to it separate courses of lectures and treatises, and by instituting ophthalmic hospitals. The diseases of the eye, in general hospitals, are inadequate from the smallness of their number, to the purposes of practical study, particularly that of exemplifying the various operations. Thus these institutions have been inefficient in reference to this important department. As the general body of surgeons did not understand diseases of the eye, the public naturally resorted to oculists, who, seeing such cases in greater numbers, became better acquainted

with the symptoms, diagnosis, and treatment; and especially more skilful in the operative department. At the same time, the subject being imperfectly understood was neglected in the general surgical courses, in which many important affections of the eye were entirely unnoticed, and the whole inadequately explained. Thus students, who resorted to London for the completion of their professional studies, had really no means of learning this important department of the profession, which was tacitly abandoned, even by the the hospital surgeons, and turned over to the oculists. The latter, not being conversant with the principles derived from anatomy, physiology, and general pathology, attended merely to the organ, and relied almost exclusively on what is comparatively of little importance, local treatment. Hence ophthalmic surgery, being in a manner dismembered from the general science, was reduced to a very low ebb. Until within a few years, it was, in this country at least, in a state of almost total darkness.

"It thus became desirable to establish an express and distinct school for diseases of the eye; not because the principles of treatment differ from those applicable to disease in general; nor because any peculiar mode of study is required; but in order to supply a deficiency in the existing sources of professional instruction; to provide for the affections of this important organ, those means of information, which the general hospitals neither do, nor could afford, consistently with their requisite attention to their other important objects. This proceeding, which at first view seems calculated to complete and perpetuate the separation, was the only rational mode of reuniting ophthalmic practice to general surgery.

"The more thoroughly any organ has been investigated, anatomically, physiologically, and pathologically, the better shall we be prepared to treat its diseases. In this respect the eye is advantageously circumstanced; its anatomy is well known; its physiology clearly made out. A considerable portion of the organ is external, and the transparency of the front enables us to see much of its interior. We can observe the phenomena of disease, and the effects of remedies in some of its internal structures, in such parts as are elsewhere hidden from our view. The observations thus made on the eye are applicable to the illustration of disease and treatment in other organs. Hence if the general principles of medical science throw light on ophthalmic affections, the history and progress of the latter reciprocally afford valuable data for general pathology.

"But, can the diseases of any organ be well studied alone? Can they advantageously be made the subject of detached and separate investigation and treatment? The numerous organs which make up the human body, although various in structure and office, are all intimately connected and mutually dependent. They are merely subordinate parts of one machine; and they all concur, each in its own way, in producing one general result, the life of the individual. All the leading arrangements are calculated to give a character of unity to the organization and living actions of our frame. There is a common source of nutrition for the whole body; a single centre of circulation; hence all parts are immediately dependent for their nourishment and growth, and for the materials of their various exertions, on the digestive organs and the circulating system. There is a common place of union for sensations and volitions: the nervous system associates the actions of the various organs, and combines them for the common purposes of the economy; by means of it, the various organs *co-operate* in the healthy state, and suffer together,

or *sympathize* in disease. Thus the individual organs are not independent. The causes of their natural functions, and of those deviations which constitute disease, are not to be found within themselves, but mostly in the state of the constitution, or in that of some leading system of organs. Hence, in order to understand any part of the body, we must know the whole; and this holds equally good in disease as in health. Suppose a person complains of weak sight, we shall not be able to remedy the defect if we attend to the eye only, for probably there may be no visible alteration in the organ. We must look to the state of the circulation in the head, to the condition of the digestive organs; we must inquire into the patient's habits, into his diet, into his general mode of living, as well as into the causes which may be acting on the eye. Until this analysis has been made, we cannot know the causes of disease, nor can we arrive at clear grounds of treatment. We ultimately find that the eye must be cured, not by any direct or local measures, but by those of general influence; by loss of blood, purging, change of diet, and of other habits.

"In such a system, then, of intricate connection and mutual influence, each part will be best understood by him who has the clearest notions of the general economy. Even the practical proceedings will be most judiciously conducted by those who are in the habit of treating disease generally; who do not confine their attention to the part. This confinement is prejudicial, by producing and confirming habits of partial and narrow views, by leading to neglect of mutual relations and influences, by encouraging local treatment. Exclusive attention to a small corner of the animal structure causes a confinement of mental vision, analogous to the near-sightedness which mechanics contract by constantly poring over the minute objects of their attention. All the habits of the oculist lead to a separation and insulation of the organ. The part is detached from the system, treated by washes, drops, ointments; and this inefficient trifling impedes the progress of ophthalmic surgery. We want, instead of this, general and comprehensive views, the aid of analogy and contrast; the whole field of medicine and surgery must be laid under contribution for the principles which are to guide us in learning the nature and treatment of ophthalmic disease. Professed oculists have done little for the science, either here or abroad. The only real and valuable improvements have proceeded from men of extensive anatomical knowledge and of great general insight into disease."

Derrick Vail.

OBITUARY

THEODORE LASATER TERRY
(1899-1946)

Theodore Lasater Terry was born February 19, 1899, at Ennis, Texas. He died September 28, 1946, at Boston, Massachusetts. Dr. Terry's preliminary education was obtained in Texas. He received a bachelor's degree from the Southern Methodist University, and his degree of Doctor of Medicine from the University of Texas in 1922. After serving his internship at the Henry Ford Hospital, Detroit, he did postgraduate work in general pathology at the University of Texas.

During the years that followed, Dr. Terry filled these hospital and teaching appointments:

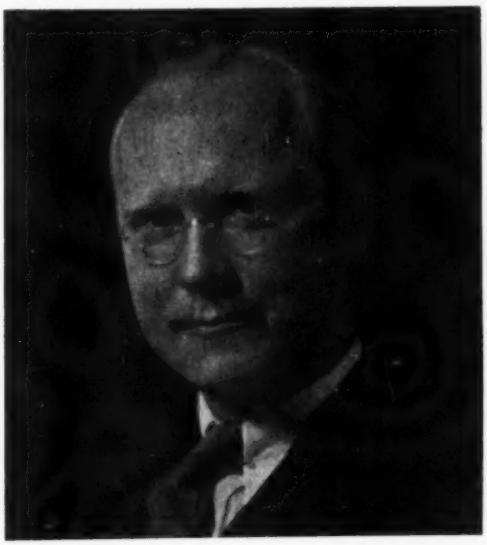
Instructor in Medicine,
University of Texas 1925
Associate Professor, Pathology,
University of Texas 1926

Ophthalmic Resident,
Massachusetts Eye and Ear Infirmary 1927
Assistant Pathologist,
Massachusetts Eye and Ear Infirmary 1928
Pathologist and assistant Ophthalmic surgeon, Masachusetts Eye and Ear Infirmary 1932
Ophthalmic Surgeon,
Massachusetts Eye and Ear Infirmary 1937
Assistant Professor of Ophthalmology, Harvard University 1940-46
Acting Head, Department of Ophthalmology, Harvard University ..
.....During the War.

An impressive record; each forward step based on diligence, hard work, and the efficient discharge of the duties of the one before—not a record of promotion by seniority, nor through influence. Nor did he rise by pulling anyone else down. But Dr. Terry, although a hard worker, was not a plodder, he had vision and ambition.

His vision and ambition appear most clearly in his work on retrolental fibroplasia. In the first place, he perceived, what was a surprise to us, that this disease is one of the most prevalent causes of infant blindness. In the next place, he regarded it as a problem; therefore, something to be solved, and he determined to devote himself to that task. Since the task was too complicated for one man, solving this problem would involve team work; so he proceeded to enlist coworkers and, finally, to organize a corporation, "The Foundation for Vision," with powerful financial support and broad aims and powers. His plan was to pursue all clues and attack the problem of retrolental fibroplasia not only from the viewpoint of the pathologist, but from that of the embryologist, the statistician, and the sociologist, as well. He was able to kindle enthusiasm in others because he had in himself the divine fire.

In addition to his affiliation with the American Medical Association, Dr. Terry



THEODORE LASATER TERRY

was also a member of the American Academy of Ophthalmology and Otolaryngology, the New England Ophthalmological Society (former president), the American Board of Ophthalmology (assistant secretary), the Association for Research in Ophthalmology (a trustee), the American College of Surgeons, and the American Association for the Advancement of Science. He was also a member of Sigma Nu, Alpha Kappa Alpha, the Harvard Club, and a lieutenant in the U. S. Naval Reserve, 1925-1927. His church affiliation was Presbyterian.

In 1942, Dr. Terry was awarded the certificate of merit from the American Academy of Ophthalmology and Otolaryngology for his research in retrolental fibroplasia, the disease which he named. If giving a disease a man's name were not taboo, retrolental fibroplasia undoubtedly would be known as "Terry's disease" because he did so much to make it known.

Dr. Terry's activities in the medical societies is apparent from a survey of the papers he published (list appended), but, like our most valuable members, he contributed much more in the discussion of papers by others than appears from a list of his own publications. Special attention may be called to his series of papers on malignant melanoma and his work on conical cornea.

Dr. Terry was married in December, 1934. Helen Terry was a true helpmate. They enjoyed travelling, especially by automobile, and had driven over a large part of this country in their specially equipped car. The unique home which they were developing was on a farm 25 miles from Boston. Always they had at hand one or two books on some topic of general interest which they were reading together—a book on history, economics, religion, politics, or especially, on the scientific advances in some field other than ophthalmology. These diverse interests made Ted an interesting companion. He was always the life of the party, a good story teller with ever a timely anecdote.

Dr. Terry had suffered repeatedly from hemorrhages from gastric ulcers and had had several operations and a dozen or more blood transfusions. He finally had the radical gastrectomy and neurotomy and was no longer threatened with this recurrent disability. Hence, it was a great disappointment to have what promised to be a most active and fruitful life cut off so prematurely by a cardiac complication.

Dr. Terry was a successful clinician and teacher, but his name will be forever associated with retrolental fibroplasia. The staggering difficulties, which beset the investigation of its cause, prevention, and treatment, served only to stimulate Dr. Terry's determination to overcome them. In this he displayed the characteristics of leadership, of enthusiasm, of patience, of scientific imagination, of tolerance of the views of others, of intolerance of any but sound scientific deductions, of ability to enlist the support and coöperation of others in what was obviously too huge a task for a single investigator.

Walter B. Lancaster.

PUBLISHED ARTICLES OF T. L. TERRY, M.D.

1. Neurogenetic tumors of the retina and optic nerve: Gliomata. Texas State Jour. of Med., 1923, v. 19, p. 379.
2. X-rays ineffective against herpes virus. Amer. Jour. Ophth., 1928, v. 11, July, p. 554.
3. The contact glass, its use in conical cornea, and errors of refraction. Guildcraft, 1931, v. 5, no. 2.
4. Histologic changes in an eye eight years after sclerocautery puncture of the retina. Arch. of Ophth., 1932, v. 8, p. 182.
5. Sarcoma of eyelid: metaplasia of leiomyosarcoma to round cell sarcoma after repeated attempted excisions. Arch. of Ophth., 1934, v. 12, p. 689. (With P. Mysel).
6. Metastatic carcinoma in both optic nerves simulating retrobulbar neuritis. Arch. of Ophth., 1933, v. 10, p. 611. (With Edwin B. Dunphy).
7. Pulsating exophthalmos due to internal carotid-jugular aneurysms: Use of thorium dioxide sol in localization. Jour. Amer. Med. Asso., 1934, v. 103, p. 1036. (With P. Mysel).
8. Angioid streaks and osteitis deformans. Trans. Amer. Ophth. Soc., 1934, v. 32, p. 555.
9. Uveal sarcoma: Malignant melanoma. Amer. Jour. Ophth., 1935, v. 18, p. 903. (With Juanita P. Johns).
10. Diathermy in cataract extraction. Amer. Jour. Ophth., 1936, v. 19, p. 1105.
11. Abnormal arteriovenous communication in the orbit involving the angular vein. Arch. of Ophth., 1938, v. 19, p. 90. (With G. B. Fred).
12. A modified corneal clamp to facilitate the insertion of stitches. Arch. of Ophth., 1938, v. 20, p. 91.

13. Some physiological and anatomical aspects of the cornea affecting its pathology. Amer. Jour. Ophth., 1939, v. 22, p. 153.
14. Studies on surface-epithelium invasion of the anterior segment of the eye. Amer. Jour. Ophth., 1939, v. 22, p. 1083. (With J. F. Chisholm, Jr. and A. L. Schonberg).
15. Care of the Eyes, published in *Health at Fifty*. Edited by Dr. William Robey, Cambridge, Mass., Harvard University Press, 1939.
16. Malignant melanoma—so-called sarcoma of uvea: II. Problems in diagnosis. Arch. of Ophth., 1939, v. 22, p. 989.
17. A plastic transilluminator. Arch. of Ophth., 1940, v. 23, p. 164. (With R. D. Mattis).
18. Malignant melanoma—so-called sarcoma of uvea: III. Extension into the optic nerve. Arch. of Ophth., 1940, v. 24, p. 206.
19. Studies on keratoconus relative to the effect of prolonged application of pressure. Amer. Jour. Ophth., 1940, v. 23, p. 1089. (With J. F. Chisholm, Jr.).
20. Common glaucoma operations: Analysis based on histologic findings. New York State Jour. Med., 1941, v. 41, p. 467.
21. Truss for application of pressure to the eye. Amer. Jour. Ophth., 1942, v. 25, March, p. 333.
22. Extreme prematurity and fibroblastic overgrowth of persistent vascular sheath behind each crystalline lens. Amer. Jour. Ophth., 1942, v. 25, p. 203.
23. Fibroblastic overgrowth of persistent tunica vasculosa lentis in premature infants: II. Report of cases, clinical aspects. Arch. of Ophth., 1943, v. 29, p. 36.
24. Fibroblastic overgrowth of persistent tunica vasculosa lentis in infants born prematurely: III. Studies in development and regression of hyaloid artery and tunica vasculosa lentis. Amer. Jour. Ophth., 1943, v. 25, p. 1409.
25. Fibroblastic overgrowth of persistent tunica vasculosa lentis in premature infants: IV. Etiologic factors. Arch. of Ophth., 1943, v. 29, p. 54.
26. Some clinical applications of fluorescence in relation to melanotic pigment. Amer. Jour. Ophth., 1943, v. 26, p. 536.
27. Retrolental fibroplasia in premature infants: V. Further studies on fibroplastic overgrowth of the persistent tunica vasculosa lentis. Arch. of Ophth., 1945, v. 33, p. 203.
28. Ocular maldevelopment in extremely premature infants: Retrolental fibroplasia: VI. General consideration. Jour. Amer. Med. Asso., 1945, v. 128, p. 582.
29. A visual defect of the prematurely born infant. Outlook for the Blind., 1945, v. 39, p. 211.
30. Development of secretory function of ciliary body in the rabbit eye evaluated from ascorbic acid concentrations and changes in volume. Arch. of Ophth., 1945, v. 34, p. 415. (With V. E. Kinsey and B. Jackson).
31. Further consideration of retrolental fibroplasia. Jour. Pediat., 1946, v. 29, no. 6.
32. Retrolental fibroplasia. (With Vacharis, Merrill King, Edwin B. Dunphy, V. E. Kinsey, to be published in Advances in Pediatrics, 1947).

CORRESPONDENCE

Misgivings as to the technique of cataract operations

Note by Dr. Crisp:

Dr. Rivas Cherif, Mexico City, has written as follows with regard to certain points at which he feels he may have been somewhat misrepresented in the editorial appearing under the above title in the American Journal of Ophthalmology for December, 1946, page 1594.

Dr. Rivas Cherif says:

My paper (referred to in the editorial) states at least a great part of the modifications or revivals of technique for extraction of senile cataract are good, useful, and advisable, but only when they are indicated. In my opinion the mistake is made in wholesale and systematic application of all the various modifications proposed by the various authors. The operator should select what seem the most useful of these proposals, omitting the less effective. It is not wrong to use innovations, but it is wrong to use a procedure, be it old or new, which is not indicated in the particular case. I am not a skeptic, but use innovations in cases in which I

believe they are indicated. I am not partial to the extracapsular method but use both methods, and I am thus in a position to compare the two. For this reason I can state positively that the postoperative reactions are comparatively less marked after extracapsular extraction. As regards the suggestion that excessive pressure may be exerted by Mexican surgeons who use the intracapsular method, I may state that in my own work I do not exert any pressure at all. Furthermore, mere tension on the fibers of the zonule is capable of causing increased ciliary reaction. As regards the question of waiting for maturity, in my opinion most patients show so much difference as to the stage of development of the cataract in the two eyes, that they are still able to use the unoperated eye after extraction of the mature cataract from the other eye. Even where the progress of the two eyes is more synchronous, there is no objection to waiting for full maturity in the second eye, and this will imply that each of the cataracts can be operated upon at maturity.

(Signed) M. de Rivas Cherif,
Mexico, D. F.

X-RAY STUDIES IN RETINOBLASTOMA

In the January, 1947, issue of the JOURNAL, two cases of retinoblastoma are reported. It is not clear whether X-ray studies of the affected globes were made. Possibly if the technique of Pfeiffer, *Archives of Ophthalmology*, 1936, volume 15, May, pages 811-821, had been used, the finding of opaque areas of calcification might have led to an earlier diagnosis.

The procedure recommended by Dr. Pfeiffer can be employed by any careful roentgenologist, as it consists only in X raying the globe to demonstrate intraocular opacities. I recall two cases in which such X-ray studies furnished decisive information.

(Signed) Loren Guy,
New York, New York.

BOOK REVIEW

OPTIQUE INSTRUMENTALE. By G. A. Boutry. 540 pages. Paris, Masson et Cie., 1946.

It is refreshing to note that so admirable and interesting a book and one so beautifully printed can be produced in war-torn Europe. This book is based on a series of lectures to students and deals with the entire subject of instrumental optics, as distinguished from geometric optics, except computation. That subject is dealt with in a separate course. Optical principles are thoroughly elucidated without mathematics beyond the capability of an ophthalmologist. However, the ophthalmologist will read the book, for the most part, because the subject delights him, and not to increase his usefulness in his profession.

There are two chapters on the optics of the human eye and the corrections of the optical defects. The analysis of resolving power is discussed with particular clarity and interest. The last section of the book consists of a number of monographic chapters on individual optic instruments—lamps, the compound microscope, telescopes, binoculars, and photographic instruments.

F. H. Haessler.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

1

GENERAL METHODS OF DIAGNOSIS

Barrios, R. R., and Barrierre, R. V. **Regarding goniophotography.** Amer. Jour. Ophth., 1947, v. 30, Jan., pp. 49-51. (10 figures.)

Ferrié, Jean. **The importance of questioning the patients for the diagnosis of ocular tuberculosis.** Ophthalmologica, 1946, v. 111, June, pp. 332-338.

The author stresses the importance of the personal and family history as a diagnostic help in ocular tuberculosis. Five case histories illustrate the etiologic problems of these diseases and their differential diagnosis.

Alice R. Deutsch.

Filatov, V. P., and Bushmich, D. G. **Modification of Baillart's ophthalmodynamometer.** Oftal. Jour. (Odessa), 1946, pt. 2, pp. 7-8.

The modifications of the instrument consist in a device which locks the indicator so that it can be read after taking the instrument off the eyeball, and in the attachment of a 13-diopter lens to the stem of the ophthalmodynamometer so that it can be used with indirect ophthalmoscopy. (Illustration.)

Ray K. Daily.

Guy, L. P. **A ruler for measurement of visual fields on the tangent screen.** Arch. of Ophth., 1946, v. 36, Nov., pp. 617-619.

A rule is described by means of which one can measure angular distances on a tangent screen. The three surfaces of a triangular rod are so calibrated that one can measure fields taken at 1, 2, and 3, meters.

R. W. Danielson.

Maggiore, L. **Modifications of the Schiötz tonometer.** Ann. di Ottal., 1946, v. 73, Feb., pp. 122-125.

The scale plate bears scales for the 5.5-gm., 7.5-gm., and 10-gm. weights in addition to the usual scale of 20 arbitrary gradations. By means of lines projected from the latter upon the other scales it is possible to read the tension directly in mm. Hg without recourse to a graph.

Not only the 5.5-gm. weight but also the 7.5-gm. and 10-gm. weights are

built into the instrument and may be brought into play, as required, by the simple turn of a lever. In this way the awkward changing of weights is avoided. Harry K. Messenger.

Pfeiffer, R. L. **Roentgenography in ophthalmic diagnosis.** Arch. of Ophth., 1946, v. 36, Nov., pp. 639.

After listing and evaluating the uses of roentgen rays in ophthalmology, the author demonstrates and discusses recent contributions of roentgenology to the study of diseases of the eye. Deposits of calcium were found in approximately 80 percent of a large series of cases of retinoblastoma and calcium was observed microscopically in only an additional small percent. Internal fracture of the orbit was demonstrated as the cause of enophthalmos when there was no external bony deformity. Intracerebral deposits of calcium were the most important diagnostic finding in toxoplasmosis (9 cases). The value of roentgenography in the study of exophthalmos was emphasized by the fact that in 70 percent of 200 consecutive cases, changes were demonstrated roentgenologically. In 42 percent of all cases the changes were diagnostic. These diagnostic findings are illustrated by the presentation of a number of examples of each.

R. W. Danielson.

Reis, J. L. **Use of "contact corneal rings" in X-ray localization of intraocular foreign bodies.** Brit. Jour. Ophth., 1946, v. 30, Aug., pp. 462-464.

The various methods used for X-ray localization of foreign bodies are all quite satisfactory; however they all require special equipment which, at least in war theaters, is difficult to obtain. The author describes a very thin metal ring, 0.1 mm. thick and 1.5 mm. wide, which he cut from sheets of lead and tin alloy in which dental X-ray films are packed. He molds the ring on an artificial eye with his finger tips and places it on the cornea so that its outer edge is directly on the limbus. The strip remains in place by natural adhesion to the cornea and by pressure of the closed lids. Anteroposterior and lateral exposures are made and the usual three-dimensional measurements taken. (3 diagrams.) Morris Kaplan.

Sheppard, E. A. W., and Romejko, W. J. **Gonioscopy.** Amer. Jour. Ophth., 1947, v. 30, Feb., pp. 159-164. (11 figures, references.)

Streiff, E. B. and Bischler, V. **The precision of the ophthalmodynamometric method.** Ophthalmologica, 1946, v. 112, July, pp. 19-24.

A thorough mathematical analysis of pertinent data demonstrates that ophthalmodynamometry is no less precise than tonometry. It should therefore take its place among the classic methods of ophthalmologic examination. (References.) F. Nelson.

2

THERAPEUTICS AND OPERATIONS

Assettati, Vincenzo. **Results obtained by intravenous administration of Petragnani's M.F. tuberculin in some cases of ocular tuberculosis.** Riv. di Oftalm., 1946, v. 1, May, pp. 292-319.

Petragnani's M.F. vaccine is an extract from tubercle bacilli treated with phenol, acetone, sulfuric acid, and formol; the partigene "fenbattacin," thus obtained, is of high antigenic power, and is used in an undisclosed solution in seven concentrations. It is believed to be stable and has been used, since 1936, in pulmonary as well as extra-

pulmonary tuberculosis. Injections were given at intervals of four to twenty days in increasing concentration for three to eight months. No unfavorable reactions were observed; local and general reactions occurred but were transient only; they seemed to introduce a definite improvement in most instances. K. W. Ascher.

Azzolini, U. **Severe involvement of cornea and of the skin during treatment with a goldarsenobenzol derivative.** Riv. di Oftalm., 1946, June, v. 1, pp. 361-373.

A 37-year-old woman developed lupus at the age of 25 years, and responded well to gold treatments, administered in two courses. After the second course, marginal infiltrations were observed in the cornea which became much worse during a third course of the goldarsenobenzol derivative. Bullous erythema developed on the face and neck, multiple deep yellowish-gray corneal infiltrations appeared and the visual acuity was reduced to the perception of hand movements. A recurrence of pleurisy, ulcerations of the mucous membranes of the larynx, severe diarrhea, and Eosinophilia accompanied the untoward reaction. Nine months later the visual acuity was 2/10 in each eye. The author discusses the allergic and idiosyncratic factors in the pathogenesis of these reactions to aurotherapy. K. W. Ascher.

Calamandrei, Giorgio. **Personal experiences with penicillin treatment in ophthalmology.** Riv. di Oftalm., 1946, v. 1, March, pp. 180-188.

Local penicillin therapy proved to be successful in cases of conjunctival disease caused by staphylococci and by gonococci; in cases due to diplobacillus Morax-Axenfeld, zinc sulphate gave better results. Penicillin ointments were found helpful in blepharitis if care was taken to combat the general deficiency. The results obtained in treatment of trachoma were not encouraging. Usually a solution containing 5000 Oxford units per c.c. was applied; in mild cases lower concentrations may be used. Penicillin will not displace all other drugs, particularly not those of the sulfa group. K. W. Ascher.

Carlevaro, Gianfranco. **Histamin for ocular analgesia.** Riv. di Oftalm., 1946, v. 1, April, pp. 245-248.

Solution of bichloride of histamin administered intradermally or by iontophoresis proved to be helpful in combatting pain connected with fifth nerve neuralgia, keratoconjunctivitis scrophulosa and other types of keratitis, scleritis, iritis, iridocyclitis, glaucoma, and ocular injury. In four patients suffering from severe pain connected with herpes zoster, daily histamin administration for a week allowed discontinuation of sedatives. While no effect on intraocular pressure was observed, preoperative histamin iontophoresis proved to be beneficial in patients suffering from acute glaucoma. K. W. Ascher.

Feldman, J. B., and Abrahams, H. J. **Fluorescent colors in tangent screen examinations.** Arch. of Ophth., 1946, v. 36, Nov., pp. 537-539.

A method is shown by which fields can be taken on the tangent screen under regular illumination and plotted with the ordinary targets now in use, but marked off by invisible fluorescent colors read under ultraviolet illumination. R. W. Danielson.

Fontana, G. **Sulfonamide treatment in ocular affections.** Rassegna Ital. d'Ottal., 1941, v. 10, May-June, p. 253.

The literature is reviewed and the result of treatment in 200 eyes is reported. Good results were obtained in catarrhal and gonococcic conjunctivitis, phlyctenular disease, and suppurative retrobulbar infections. Unfavorable results are reported in trachoma with corneal complications and in acute dacryocystitis. E. M. Blake.

Harris, R., McGavack, T., and Elias, H. **The nature of the action of dimethylaminoethyl benzhydryl ether hydrochloride (benadryl): effects upon the human eye.** J. Lab. and Clin. Med., 1946, v. 31, Oct., pp. 1148-1152.

The pupillary size and visual acuity of 20 ambulatory patients, free from ocular and autonomic disease, were studied before, during, and after the use of benadryl orally in doses of 150 to 400 mgm. daily, for 3 to 12 weeks. No perceptible change was noted.

In 60 subjects, 21 to 65 years of age, fresh 0.5-percent aqueous solution of benadryl was instilled each ten seconds for three doses into the right eye. In 48 patients the pupil increased an average of 1.9 mm. at the end of one hour, and in 12 patients there was no change in the pupil size. Dilatation started to decrease in two hours and was measurable at the end of 24 hours in only four patients. The visual acuity was decreased in 12 patients and unchanged in 48, and the accommodation was decreased in 43 patients. No change was noted in pupillary size or accommodation in any left eyes at 1, 15 and 60-minute intervals.

In six patients one drop of 1/1000 epinephrin solution was instilled with the three benadryl drops, which led to maximum dilatation in 15 minutes, but the dilatation was not greater than in those who did not receive the epinephrin.

One percent solution of homatropine sulphate caused a greater increase in pupillary size in 15 subjects, when benadryl drops were added than alone. Benadryl lessens the miosis produced by eserine. Applied topically to the human eye benadryl seems similar to atropine in paralyzing the vagus. (2 tables, references.)

Bennett W. Muir.

Iliff, C. E. **Beta irradiation in ophthalmology.** Trans. Amer. Acad. Ophth., 1946, Sept.-Oct., pp. 36-46.

Because of its limited penetration and ease of application, beta irradiation is especially suited for radiation therapy of the anterior part of the eye. A special soda-glass-windowed brass applicator containing 200 to 500 mc of radon is applied at a distance of 1 to 3 mm. from the lesion. The dosage is measured in gram seconds, 12 is the maximum for one treatment and 18 for a two-week series. After rest periods of two weeks, one or more series may be subsequently given. In 60 patients with vernal conjunctivitis 18 percent were cured, 63 percent were improved, and 7 percent were unimproved. Of 72 eyes with anterior ocular tuberculosis, vision was improved in 42 percent, maintained in 46 percent, and decreased in 12 percent. In 24 cases of benign tumor of the lids and conjunctiva, mostly angiomas and papillomas, the results were excellent. In chronic corneal affections where it is desirable to decrease vascularization the results were good. Chas. A. Bahn.

Jona, Sergio. **Investigations concerning the action of choline and some choline esters on the normal human eye.** Riv. Oto-Neuro-Oft., 1941, v. 18, Nov.-Dec., pp. 510-529.

Choline, acetylcholine, Doryl, mech-

olyl, and lymphogangline were used on four normal persons to study the effect of instillation into the conjunctival sac. Pupillary diameters, intraocular vascular pressure, caliber of the retinal vessels, and intraocular pressure are shown in extensive tables. In some experiments the instillation of pilocarpine, or homatropine preceded the drug to be studied. Some experiments were performed by subconjunctival administration of the solution. Instillation of choline, acetylcholine, and lymphogangline did not produce marked changes whereas doryl instillation was followed by a definite decrease of tension; subconjunctival injection of choline and of lymphogangline induced a slight fall of intraocular pressure. A decrease of the retinal arterial blood pressure and an increase of the diameter of the retinal arteries followed subconjunctival injection of lymphogangline. K. W. Ascher.

Katzin, H. M. **Animal operating equipment for experimental ocular surgery.** Arch. of Ophth., 1946, v. 36, Aug., pp. 215-219.

An operating table mounted on the elevating table of a Zeiss slit lamp is described. The swinging arm of the slit lamp is utilized to hold a microscope or camera. Illumination is provided by a hammer lamp mounted on a gooseneck. The animal, usually a rabbit, is fixed to the table by adjustable leg clamps. A circular hand rest is provided. Details of the construction and utilization of the table are given.

John C. Long.

Kuhn, H. S. **Sodium sulfacetimide 30-percent solution in ophthalmology.** Trans. Amer. Acad. Ophth., 1946, May-June, pp. 210-213.

Dickson, in Scotland, found the incidence of ulcers among miners after the removal of foreign bodies was markedly reduced by the use of 10 percent sodium sulfacetimide, which in England goes under the name of "Albucid."

Kuhn routinely uses a drop of the 30 percent solution every four hours for three days, after the removal of a foreign body. The ointment may be used nightly if there is conjunctivitis. Neither the drops nor ointment are irritating and no allergic reactions have occurred. Chas. A. Bahn.

Leopold, I. H., and LaMotte, W. O., Jr. **Influence of penicillin on the course of ocular lesions due to a toxic agent.** Amer. Jour. Ophth., 1947, v. 30, Jan., pp. 41-48. (6 figures, references.)

Maione, Mario. **Experimental and clinical contribution on the antiseptic action of mercurochrome in ophthalmology.** Ann. di Ottal., 1946, v. 73, Feb., pp. 114-121.

Mercurochrome was introduced into Italy in 1942. Tests made in vitro with conjunctival flora show that it has greater antiseptic properties than protargol and mercury oxycyanide. Experiments made in vivo show that it can kill germs in the conjunctival sac and that it can be used advantageously in septic affections of the globe and its adnexa.

Maione proposes its administration in the form of gelatin disks so as to avoid contact with the skin. The undesirable local reactions described by others may be due to contact with the acid perspiration of the lids. Mercurochrome is precipitated in an acid medium, with the formation of irritating compounds, but is not precipitated in the alkaline medium of the conjunctival sac. With alkaloids it forms insoluble compounds, but Maione concludes that

mercurochrome and neutral atropine sulfate may be used together without any danger. Harry K. Messenger.

Marconcini, Eraldo. **The action of the amide of nicotinic acid on the optic nerve of animals (rabbits) poisoned by quinine (hydrochloride).** Arch. di Ottal., 1946, v. 50, Jan. and Feb., pp. 19-43.

The therapeutic uses of nicotinic acid and its amide in ophthalmology are reviewed. Rabbits were given 180-240 milligrams of quinine hydrochloride intramuscularly for nine to twelve days, after which one eye was enucleated. After one day of rest the rabbits were given nicotinamide for 14 to 24 days, when the remaining eye was enucleated.

The first eye showed the usual degeneration of the myelin sheaths. The nerve of the other eye showed an almost complete regeneration of the myelin tissue and disappearance of the fatty degeneration characteristic of quinine poisoning.

The author assumes that the improved metabolism due to the vasodilating action of the nicotinamide, and the increased gaseous exchange, that is ascribed to the action of nicotinamide may explain its action on the elements of the optic nerve.

Francis P. Guida.

Moreu, Angel. **Chemotherapy of ocular infections.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Sept., pp. 797-802.

The treatment advocated by Moreu consists of a massive dose of foreign protein, large oral doses of sulfa drugs, paracentesis and evacuation of the anterior chamber 24 hours after institution of treatment, and autohemotherapy every 48 hours, if necessary. In serpiginous ulcer a contact lens filled with the patient's blood is applied to the cornea, to bathe the cornea in blood which has a high concentration of the sulfa drug, and to stimulate the local defensive forces. These procedures invariably arrested the process in 18 cases of purulent iridocyclitis and serpiginous ulcer. Ray K. Daily.

Payot, Pierre. **The influence of anesthetics on histamine chemosis in rabbits.** Ophthalmologica, 1946, v. 112, July, pp. 25-38.

A five-percent aqueous solution of histamine (-HCL) instilled into the eye of a rabbit produces a conjunctival chemosis after approximately five minutes. If an anesthetic, such as cocain, is applied first, the degree of chemosis is considerably reduced. This inhibition is not ascribed directly to an antihistamine action or to an affect on the nerves. The anaesthetic holocain produces chemosis by itself. (1 curve, 1 table, references.) F. Nelson.

Regoli, A. **Concentration of sulfapyrodine in the aqueous after local application.** Rassegna Ital. d'Ottal., 1941, v. 10, May-June, p. 269.

Experiments on rabbits revealed a good concentration of the drug after application of ointments and instillation into the conjunctiva, and an even higher concentration after subconjunctival injection. Intraorbital injection produced very slight concentrations in the aqueous. E. M. Blake.

Sorsby, A., and Ungar, J. **Pure penicillin in ophthalmology.** Brit. Med. Jour., 1946, Nov. 16, pp. 723-731.

Penicillin in use up to a few months ago contained 80 to 90 percent of impurities; now most of it is up to 80 per-

cent pure and limited quantities of pure penicillin are available.

The pure substance combined with calcium or sodium is crystalline, yellowish white, freely soluble, and more stable than commercial (impure) penicillin. The dry form remains stable at room temperature for many months. Aqueous solutions, if kept sterile, remain active at room temperature for 14 days and retain potency up to four weeks if kept on ice. One milligram of pure penicillin corresponds to 1660 units.

Commercial penicillin in the usual clinical doses, used systematically, does not penetrate into the interior of the eye. Locally, in the conjunctival sac, it is not tolerated. It gives rise to hyperemia, discomfort, and sometimes to damage of corneal epithelium. Subconjunctivally, the eye tolerates from 600 to 2000 units in 0.5 mils of water.

Tolerance experiments with pure penicillin were performed on rabbits' eyes. Guinea pigs were unsatisfactory for study. Drops and ointments in concentrations up to 100,000 units per mil or gram were well tolerated in the conjunctival sac. Up to 50,000 units in 0.5 mils of water can be injected subconjunctivally, and intravitreal injections of 10,000 units in 0.2 mils can be made. Pure penicillin should be dissolved in water rather than in normal saline solution to avoid a hypertonicity. Anterio chamber infections in experimental animals were readily controlled by the use of concentrated ointment and subconjunctival and systemic injections. Aqueous therapeutic levels of the drug may be maintained by the use of concentrated ointments in the conjunctival sac but higher and more persistent levels are secured by conjunctival injections. Systemic massive doses may be adequate but evanescent. Adrenalin in the solution used for subconjunctival injections increases persistence. Intramuscular beeswax injections give more sustained levels.

Francis M. Crage.

Souders, B. R., and Forestner, H. J. **Plastic ocular prostheses in unusual sockets.** Trans. Amer. Acad. Ophth., 1946, Sept.-Oct., pp. 46-52.

A method of socket impression and prostheses especially adapted to deformed sockets is described and illustrated with two case reports. For the impression a finely powdered alginate gel is used which sets in from two to five minutes. An impression tray of acryllic resin with a scleral radius of 12 mm. and a corneal bulge of 7.5 mm. is located slightly nasal to the center of the tray. A plaster bowl, Jaeger spatula, iris spatula, and muscle hook comprise the rest of the equipment. The technique involves the mixture, molding, impression, and trimming of the impression material, also the fabrication of the prosthesis which is made of methyl methacrylate. The iris is colored with oil pigments or a glass iris from another prostheses is used. (18 figures.) Chas. A. Bahn.

Van Loon, J. A. **The cold pressor test in ophthalmology.** Ophthalmologica, 1946, v. 112, Aug., pp. 63-71.

The cold pressor test is a standard method for measuring the reaction of the vascular system. The blood pressure is measured at regular intervals (at first every 30 seconds, then every minute) after immersion of the hand into ice water. Normally the rise in systolic and diastolic blood pressure does not exceed 12 and 10 mm. Hg respectively. A greater rise is called a hyperreaction and is seen in hypertension. Patients with spasm of the retinal

arteries have a systolic and diastolic hyperreaction even when the blood pressure is normal. Patients with thrombosis of the central vein of the retina usually have affections of the heart and blood vessels, but react normally to the cold pressor test, except when they have coexistent hypertension. In eight patients with visual disturbances who for various reasons had increased vasomotor irritability (quinine or nicotine poisoning), a distinct hyperreaction to the cold pressure test was also found. (4 figures, 2 tables, references.) F. Nelson.

Vorisek, Elmer A. **Evaluation of the newer therapeutic agents in ophthalmology.** Amer. Jour. Ophth., 1947, v. 30, Jan., pp. 29-40. (References.)

3

PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Adrian, E. D. **Rod and cone components in the electric response of the eye.** J. Physiol., 1946, v. 105, July 15, pp. 24-37.

The electric response of the human eye to a flash of light can be divided into a rapid component apparently associated with the photopic mechanism, most prominent with long wave-length light, and a slow component of the scotopic mechanism, most prominent with short wave-length light. Records obtained from monkeys, whose vision is nearest that of man, and pigeons, who have good colour vision and many cones, showed in each species the dual type of response. The scotopic component was smaller in pigeons than in the other two. Records from cats and rabbits, which have few cones, and guinea-pigs, in which rods predominate, gave tracings in which it was impossible to distinguish two components. The light adapted rod mechanism of the guinea pig gave a response which resembles the photopic effect. Records were also made of the optic nerve of the cat, rabbit, and guinea pig, and from the striate area of the monkey brain, which showed little more than the apparent lack of correspondence between the electric response of the eyeball and the discharge of impulses from the retina. (17 figures, references.)

Bennett W. Muir.

Beach, S. J. **Current problems of myopia.** Trans. Amer. Acad. Ophth., Nov.-Dec., 1945, pp. 66-70.

Groups of myopic patients were classified according to the distances at which the use of uncorrected vision caused the most discomfort. A small number of patients had discomfort at all distances; a much larger group had discomfort especially for distance; a small group had symptoms for middle distance; and an inconsistent group had symptoms especially following close work. Most of the subjects with low myopia were found in the second and fourth group. The criteria of myopia included visual acuity test, retinoscopy and refraction in cycloplegia, and near point tests.

Squeezing and retraction theories of myopia and some practical problems in the author's experience are discussed.

Chas. A. Bahn.

Chapanis, A. **The dark adaptation of the color anomalous.** Am. J. Physiol., 1946, v. 146, Aug., pp. 689-701.

A relationship between dark adaptation and color blindness was found in recent studies of color defectives. Results of red and violet dark adaptation tests on red anomalous, violet anomalous, and normal subjects are given.

F. M. Crage.

Cotlier, I. **Applications of the colored velonoscope in the study and final correction of astigmatism.** Anales Argentinos de Oft., 1946, v. 7, Jan.-Feb.-March, pp. 1-6.

Using the technique of Trantas, but employing a colored velonoscope, one can determine, by movement of colored shadows, whether astigmatism exists, the direction of movement of the principal meridians, and the dioptric strength of these meridians. The author's method simplifies and makes more secure the older technique of velonoscopy. (Bibliography, 5 illustrations.) Edward Saskin.

Dallos, J. **Sattler's veil.** Brit. Jour. Ophth., 1946, v. 30, Oct., pp. 607-613.

Sattler's veil is the name given to the haziness that occurs in the vision of contact lens wearers as a result of corneal edema. It has been ascribed to "internal suffocation" as a result of interference with the circulation of the blood. "Outer suffocation," due to the elimination of free access of air to the cornea has also been postulated. To test this theory, Dallos drilled several tiny holes in the corneal part of his lenses near the upper part of the limbus. In two patients there was some increase of tolerance of the contact glass. The essential characteristics of an adequately fitted contact glass are discussed. Morris Kaplan.

Deloge, C. **Visual reëducation in aniseikonia.** Ann. d'Ocul., 1946, v. 179, March, pp. 149-157.

Inequality of the retinal images of more than four degrees usually produces symptoms. Inequalities may be constitutional or acquired and include anisometropias of more than two diopters, conical corneas, and other abnormalities which change the size or shape of one or both retinal images. A psychic struggle results because the visual images are not blended into a harmonious three dimensional concept, but each eye struggles with the other for supremacy.

The optical treatment of anisikonia is accomplished by contact glasses and by lenses with the proper combination of thickness, curve, and index of refraction to equalize the size of the two retinal images. Prismatic glasses are of no value. The optical treatment is complicated by the fact that the size and shape of retinal images vary with the distance of the object viewed. The author believes that the Dartmouth school has secured great optical accuracy in the measurement of anisikonia but has not sufficiently emphasized the human factor in its treatment. The author examined a series of patients with anisometropia with the diploscope of Remy. Several with severe monocular amblyopia with and without high refractive errors were greatly improved by monocular occlusion of the better eye. In the second stage of treatment he strove for the production of alternating vision; and in the third for the development of simultaneous vision. During the first stages of orthoptic training slight strabismus or nystagmus may be observed. The symptoms associated with anisikonia do not exist if one eye is suppressed as in using a monocle. (References.)

Chas. A. Bahn.

Doesschate, J. T. **Visual acuity and distribution of percipient elements on the retina.** Ophthalmologica, 1946, v. 112, July, pp. 1-18.

The author presents a theoretical, largely mathematical analysis of pertinent known data. Theoretically one would expect the visual acuity to be di-

rectly proportional to the number of percipient units per unit of retina. This is true for a central area whose radius is 10 degrees. That it is not true beyond this circle is explained by assuming that in the retinal periphery percipient units consist of groups of percipient histologic elements. The total number of percipient units appears to be the same as the number of fibers in the optic nerve. (3 figures, 5 tables, references.) F. Nelson.

Druault, A. **Visual symptoms following the use of the microscope.** Ann. d'Ocul., v. 179. March, 1946, pp. 138-142.

In the use of monocular instruments such as the ordinary ophthalmoscope, retinoscope, and keratometer, the closure of the nondominant eye or the suppression of its visual image is necessary for those who are not ambiocular. After prolonged use of these instruments the author reports a frequent doubling of horizontal but not of vertical lines. This is attributed to a mechanical modification of the lens caused by a peculiar type of accommodation involved, and is further increased by faint transverse folds in the corneal epithelium that result from decreased winking and increased pressure of the lids. In the use of monocular optical instruments, the relationship between accommodation and convergence is disturbed. Accommodation is relaxed, but the tendency for convergence is maintained. This results in frequent homonymous diplopia of nine prism diopters or less and may be demonstrated by placing a red glass before the observing eye. The addition of a +1.50-diopter sphere to each eye may reduce symptoms. If they continue, a frosted glass may be worn before the nonobserving eye. Chas. A. Bahn.

Gardner, H. O. **Obstacles in the orthoptic treatment of squint.** Jour. Iowa State Med. Soc., 1947, v. 37, Jan., pp. 17-21.

The most frequent causes of failure are amblyopia, suppression, abnormal retinal correspondence, vertical imbalances and poor cooperation of parents or child. The treatment of amblyopia succeeds best before the age of six years, and requires corrective lenses, and constant, complete occlusion of the fixating eye. Suppression and abnormal retinal correspondence are best treated by occlusion and stimulation on a major amblyoscope. The most common cause of failure is an uncooperative parent. I. E. Gaynon.

Goldmann, H. **A directly registering adaptometer based on a new principle.** Ophthalmologica, 1944, v. 107, Jan.-Feb., pp. 55-59.

The author describes his mathematically exact registering adaptometer. The instrument covers a wide range of intensity of illumination (1 to 10^{-5}) and registers the data as a logarithmic graph. This instrument gives a complete and exact adaptation curve such as is desirable for purposes of research. (3 drawings, 1 picture.)

Max Hirschfelder.

Hartridge, H. **Colour receptors of the human fovea.** Nature, 1946, v. 158, July, pp. 97-98.

A retinal micro-stimulator, consisting essentially of a microscope used in reverse, which presents to the eye of the observer a greatly diminished image of a white test-light, was devised. With this it was possible to move a narrow exploring pencil of light slowly and under control over the fovea, and to test point by point the colour vision of the chosen retinal area. In some

places the light appeared red (matching light of 6,400 A), in others green (matching light of 5,400 A), in others blue (matching light of 4,800 A), and between these points numerous other areas with nonspecific white or yellow response. The precise positions of these points could be measured as the distance from the test-light from the fixation light. From these data it was inferred that the Young trichromatic theory of colour vision is substantially correct, with additional yellow or white receptors, or both, that fixation can be so precise that it is possible to stimulate either single cones or very small groups of cones, and that it has been possible to identify with the precision of at least half "the cone intercentre distance" the position of some of the receptors which possess specific colour properties. Bennett W. Muir.

Holmes, W. J. **Night vision.** Arch. of Ophth., 1946, v. 36, Aug., pp. 141-154.

Two hundred and seventeen high school students of Japanese ancestry and an equal number of Caucasian ancestry were subjected to identical tests of their day vision, night vision, and yellow and blue perception. There was no perceptible difference in the corrected day vision of the two groups. Myopia or myopic astigmatism was found in 28.11 percent of the Japanese children and in 5.07 percent of the Caucasian. Blue and yellow perception was essentially normal in each group. The Japanese as a whole did less well in all of the tests for night vision. The results obtained with the S. A. M. Night Vision Tester, with the Hecht-Shaler adaptometer and in the Harman, Ferree-Rand, and Luckiesh-Moss tests are analyzed. Various theories are stated to account for the definite difference in night visual acuity in the two groups. These include hereditary factors, such as questionable embryologic and morphologic differences between the two races, greater frequency of myopia and trachoma among the Japanese, and inadequate dietary intakes of vitamins A and B and of calcium, and abnormal ration of calcium and phosphorus in the Japanese diet. John C. Long.

Kirschberg, L. S. S. **Depth perception and flying ability.** Arch. of Ophth., 1946, v. 36, Aug., pp. 155-170.

This is an analysis of data gathered in the examination of trainees in the Royal Canadian Air Force. Binocular depth perception was measured with a modification of the Verhoeff instrument. It was found that with this instrument in a single test a subject's binocular depth perception could be classified as "good," "average," or "poor." Among 303 student pilots there was a strong indication that good visual acuity is an important factor in depth perception. In a series of 504 aircrew trainees it was shown that amplitude of fusion and depth perception scores were independent of one another. It was further shown that there was a relationship between the performance on the instrument used to measure amplitude of fusion (Worth Amblyoscope) and the instrument used to determine desire for fusion (Harman Diaphragm). It was not possible to demonstrate any definite relationship between desire for fusion and depth perception, nor was there a demonstrable relationship between depth perception scores and heterophoria. There was a complete lack of relationship between depth perception and flying ability. Also there was no relationship to flying ability and orthophoria or desire for fusion. John C. Long.

Lauber, Hans. **The performance of the visual field.** Revue Bulgare d'Opht., 1943, v. 2, pp. 95-99.

The author presents a three-dimensional model that exhibits the characteristics of the visual field, a so called field island. The top of the island corresponds to the fixation point, the isopters are shown in planes, at successive levels. The blind spot forms a vertical channel which extends down to the zero-plane. (7 figures, references.)

Alice R. Deutsch.

Ludvigh, E., and Kinsey, V. E. **Effect of long ultraviolet radiation on the human eye.** Science, 1946, v. 104, Sept. 13, pp. 246-247.

In seven individuals, the foveal light-difference sensitivity and critical flicker frequency of each eye was tested before and after the exposure of the left eye only for five minutes to light which had been filtered so as to contain rays near 360 mu. There was no statistically significant difference in the results as a consequence of the exposure, from which the authors conclude that ultraviolet radiations greater than 320 mu encountered in nature are without deleterious effect upon those two functions of the human eye. (1 figure, references.)

Bennett W. Muir.

Maggiore, L. **Device for doing dynamic skiascopy with a hand electric ophthalmoscope.** Ann. di Ottal., 1946, v. 73, March, pp. 183-187.

The device is essentially a plate of transparent glass and a 3-cm. opaque black disk with a central 3-mm. round sighthole. These are in a mounting for attachment to the ophthalmoscope handle in place of the ophthalmoscope head. The plate is mounted at an angle of 45° in front of the disk. Light from the lamp in the handle is reflected by the polished surfaces of the plate into the patient's eye, and light reflected back from the fundus of the latter passes through the plate into the observer's eye behind the sighthole. Retinoscopy can thus be performed in the same manner and on the same optical principles as with a plain mirror with a central opening.

(The term "dynamic skiascopy" is used in contradistinction to Strampelli's "static skiascopy," but the method is the same as our ordinary retinoscopy.)

Harry K. Messenger.

McCulloch, C., and Crush, M. **Clinical aspects of stereopsis.** Arch. of Ophth., 1946, v. 36, Aug., pp. 171-188.

The authors report upon a series of studies conducted in the Royal Canadian Air Force. Stereopsis and suppression were measured in the synoptophore with specially prepared slides that gave quantitative measurements. Stereoptic acuity varied directly as the visual acuity. Decrease in stereoptic acuity accompanied increase in the amount of the suppression. Unilateral or bilateral myopia or myopic astigmatism with vertical axis reduced stereoptic acuity in proportion to the increase of the error. Acuity of stereopsis was reduced but could be maintained partially in myopic astigmatism with horizontal axis, any hypermetropic astigmatism, and in anisometropia. Acuity of stereopsis was not affected in hypermetropia. Increase in the size of the test objects improved stereoptic acuity. Increase in the separation of the test objects decreased stereoptic acuity. Convergence, heterophorias, age, and accommodation showed no correlation with acuity of stereopsis.

John C. Long.

Plicque, J. **Analysis of binocular vision.** Ann. d'Ocul., 1946, v. 179, Feb., pp. 83-102.

Fixation in binocular macular vision and depth perception are greatly facilitated by the decussation of the macular fibers in the superior colliculus. The size of retinal images may be measured with the eiseconemeter, the Remy diploscope, the aparatus of Gramont, or the stereoscope. Binocular perception of depth is an instantaneous phenomenon which depends upon bilateral integration of occipital lobe impulses derived especially from the macula. Depth perception may be altered by the stereoscope which changes the normal binocular relationship between accommodation, convergence, and distance estimation. A slight change of angulation and decentralization on stereoscopic charts changes the estimation of distance. Binocular vision is largely macular vision and therefore depends on cone function. Beyond a 15 degree radius from the macula peripheral vision is supplementary. Physiologic diplopia is of little importance in binocular vision. In the maintenance of binocular vision accommodation, convergence, and extraocular coordination of the extraocular muscles are essential. Conditions which affect the easy integration of the occipital macular impulses of both eyes such as anisomotropia, anisocoria, and conical cornea interfere with binocular vision. (References.) Chas. A. Bahn.

Ribas Valero, Ramon. **The stenopeic slit.** Arch. de la Soc. Oft. Hisp.-Amer., 1946, v. 6, April, pp. 384-409.

This is a detailed description of the technic of examination for astigmatism by means of the stenopeic slit. Two methods are described in one the stenopeic slit is used with the astigmatic dial, and in the other with optotypes. Ray K. Daily.

Richardson, J. A., and Kinard, F. W. **Effects of vitamin A administration upon defective color vision.** South. Med. J., 1946, v. 39, Oct., pp. 811-813.

Twelve healthy medical students were given fifty thousand units of vitamin A daily and seven were given placebos for a period of eight weeks. Improvement in color vision as tested with pseudoisochromatic charts was negligible. I. E. Gaynon.

Sasiain, M. R. **The effect of altitudinal hypoxemia on the light sense, color sense, and the visual field.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Sept., pp. 721-737.

These studies were made in a pressure chamber, corresponding to an altitude of 5,000-5,500 meters. Below 4,000 meters the hypoxemia can be compensated and the normal physiologic functions maintained. Above 6,000 meters compensation is impossible and pressurized equipment is essential. The altitude of 4,500 to 5,000 meters represents an intermediate zone, in which the hypoxemia can be compensated to the extent of avoiding syncope, but not to the extent of eliminating all phenomena produced by it. The central visual acuity, ocular tension, and the caliber of the central retinal artery are not affected by altitude. In 25 young men without nutritional deficiencies the light sense was found diminished with altitude. The recuperation time after dazzling is shorter at an altitude than on the ground. In 80 out of 100 tests the light sense improved with dark adaptation, and in 20 it diminished in spite of dark adaptation. The color

sense was investigated in 70 young men of whom 64 had trichromatic color vision and six dichromatic. It was found that in normal trichromatic subjects the color sense is not affected by altitude. Dichromatic and protanopic subjects become more deuteranopic with altitude and deuteranopia is exaggerated. The visual field was tested on the Forster perimeter with 1-cm. objects, on 20 young men, of whom 14 were emmetropic and six were myopic. It was found that the visual fields for white, red, yellow, and blue become contricted with altitude. The degree of the constriction varies in different individuals, and for different colors; the average is between 4 and 10 degrees. The field for green shows a constant extension with 15 degrees as the maximum, and 1 degree as the minimum, and an average of five. This widening of the field for green is smaller, more regular, and constant, than the constriction for white and other colors. Ray K. Daily.

Sasiain, M. R. **The situation of the far point of the emmetropic eye.** Arch. de la Soc. Oft. Hisp.-Amer., 1946, v. 6, April, pp. 362-366.

This laboratory investigation was made on 40 persons who focused for clearest vision while looking through a telescope with oculars ranging from minus six to plus six diopters. On the basis of this study, supported by a review of the literature the author concludes that the punctum remotum of the emmetropic eye in repose is not at infinity. The eye at rest is accommodated for a finite distance of about two meters, where the far point of the eye is. The eye is capable of a negative accommodation for fixation at infinity, the amplitude of which is 0.80 diopter as a maximum. The mechanism of negative accommodation is as yet uncertain. (2 graphs.) Ray K. Daily.

Shevalev, V. E. **A simplified prismoptometer.** Oftal. Jour. (Odessa), 1946, pt. 2, pp. 34-38.

Shevalev combined the two prisms, which constitute this instrument, in such a way that they can be placed in a trial frame behind the correcting lenses. This simplified arrangement makes easily available an otherwise expensive instrument. He believes that the instrument provides a reliable means for performing a rapid subjective refraction test. (7 illustrations.)
Ray K. Daily.

Slaughter, Donald. **Sulfonamides and dark adaptation.** J. Lab. and Clin. Med., 1946, v. 31, Sept., pp. 987-990.

Three groups of six individuals, were given four grams of sulfanilimide, sulfathiazole and sulfadiazine, respectively, for three days. Dark adaptation, as measured by the Feldman adaptometer, was not altered by sulfathiazole, sulfadiazine or sulfanilimide.
I. E. Gaynon.

Van der Velden, H. A. **The number of quanta necessary for the perception of light of the human eye.** Ophthalmologica, 1946, v. 111, June, pp. 321-331.

A method for the determination of the number of absorbed quanta in the visual purple necessary for the perception of light in rod vision is described. From the observation of light flashes it is possible to fix this number without knowing anything about the part of light absorbed by the visual purple.

The experimental technique is described and the mathematical analysis of the data is discussed in detail. The agreement between theory and experiment is emphasized.

The experiments indicate that two effective quanta are needed for the creation of a light stimulus and that a cooperation between two rods which each have undergone a change of one light-quantum are essential. This is in accordance with the concepts of nerve physiology. (4 figures, references.)

Alice R. Deutsch.

Viallefont, H. **Entopic examination of the retinal arteries.** Ann. d'Ocul., 1946, v. 179, March, pp. 127-130.

Oblique scleral transillumination through the closed lids preferably in the lower nasal quadrant, is followed by entopic visibility of the retinal vessels and disc. This is the familiar Purkinje phenomenon which may be easily demonstrated by pressing against the lower lid an ordinary electric ophthalmoscope with the head removed. Both eyes should be closed and the patient should look somewhat nasally, while the ophthalmoscope is moved in a rotary manner. The retinal vessels appear as brown lines on a dark pink background. By increasing the pressure of the ophthalmoscope on the eyeball, the author observed a bright stellate figure with undulating lines which appear and disappear synchronously with the radial pulse. The exact mechanism of this pressure reaction is not understood, nor why it radiates about the disc rather than the macula. Its further study is suggested in conditions with altered intraocular and intravascular pressure relationships, such as glaucoma, aortic insufficiency, and vascular hypertension. Chas. A. Bahn.

4

OCULAR MOVEMENTS

Davies, C. **Orthoptic treatment of convergence insufficiency.** Canad. M. J. 1946, v. 55, July, pp. 47-49.

Convergence insufficiency bears no relationship to refraction, and is not cured by correcting refractive errors, except occasionally in under-corrected myopia and over-corrected hypermetropia. Prisms will not cure it because they do not develop a convergence reserve. Operation has not proved satisfactory in the author's experience. Extreme insufficiency, however, may become heterophoria. Convergence insufficiency may occur at any age from adolescence to the late fifties. Subjective symptoms are fairly constant. Measurements with Maddox rod and screen test are not diagnostic. They do not indicate convergence reserve. Repeated convergence on a test object is a quick and accurate test for convergence insufficiency.

Seventy percent were cured. The failures usually had complicating factors such as aniseikonia, physical or nervous disturbances. Cures were only possible when there was a good fusion amplitude with fusion reserve and a good recovery point. Some people became comfortable after a few treatments and failed to return until their symptoms recurred one to three years later. The correction of convergence insufficiency with esophoria was found to take the longest time because correct abduction had to be taught as well as adduction. Some typical cases are reported in brief. Theodore M. Shapira.

Lijó Pavía, J. **The orthofusor, amblyoscope, and prisms; indispensables in the treatment of strabismus.** Rev. Oto-Neuro-Oft., 1945, v. 20, Nov.-Dec., pp. 142-154.

To treat properly any given case of strabismus it is necessary to determine the visual capacity, the surgical need and procedure, to prescribe the proper optico-prismatic aid, and to reëducate

or perfect the visual capacity through the amblyoscope and orthofusor. The orthoptic training reduces any existing amblyopia, treats abnormal retinal correspondence, and encourages binocular single vision. The author advises stimulation of binocular vision soon after (10 days) operation has been performed, and the early use of occlusion. The angle of anomalous retinal correspondence must be determined and overcome early. (Such a condition may be associated with triplopia.) Finally, the depth perception is investigated and retrained with stereograms. Eleven patients are described. They had strabismus with or without abnormal correspondence, and were definitely helped by orthofusor training. (Bibliography, 11 photographs.) Edward Saskin.

Santoro, Nicola. **Tuerk's syndrome associated with Marcus Gunn phonomenon.** Riv. Oto-Neuro-Oft., 1941, v. 18, no. 4, pp. 300-311.

A 13-year-old girl had fibrous degeneration of her right external rectus muscle, that resulted in retraction of the right eye upon adduction, and made abduction of the right eye beyond the midline impossible (Tuerk's syndrome). There was also ptosis of the right upper lid which could be raised only if the patient opened her mouth or performed chewing movements (Marcus Gunn phenomenon). The author does not believe that this rare combination of muscular disturbances was produced by a single pathogenetic factor. He prefers to explain the retraction phenomenon as a birth injury, and the jaw winking phenomenon by a mechanism of nervous synergy, the site of which he does not determine. (6 photographs.)

K. W. Ascher.

Spaeth, E. B. **The Marcus Gunn phenomenon.** Amer. Jour. Ophth., 1947, v. 30, Feb., pp. 143-158. (10 figures, references.)

5

CONJUNCTIVA

Aguilar, Jose. **A case of resistant pneumococcus conjunctivitis.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Nov., p. 1001.

A pneumococcus conjunctivitis that had resisted all forms of local therapy for three months responded in a week to sulfathiozol compresses. The diagnosis and the cure were verified bacteriologically. Ray K. Daily.

Amat. M. M. **A rare complication of vernal conjunctivitis.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Nov., pp. 994-1000.

A 41-year-old woman had central corneal ulcers of both eyes caused by the irritation of the excrescences of vernal conjunctivitis. In the left cornea the untreated ulcer led to corneal perforation. In the spring she had a dermatitis of the hands and face. Because of corneal ulceration the left eye was bandaged for a long time; this not only resulted in the healing of the corneal ulcer, but the conjunctival excrescences disappeared, and the conjunctiva assumed a normal apeparance. The right eye, which remained open had at the same time a florid vernal catarrh. The author advocates the Blascovics operation in this disease. Ray K. Daily.

Baxter, C. R. **Reiter's disease.** Brit. M. J., 1946, Dec. 7, p. 858.

A case of Reiter's disease is interesting because all of the symptoms except diarrhea and hematuria were exhibited and for the sequence of their appearance—conjunctivitis, urethritis, then

polyarthritis and keratodermia coincidentally, and a concomitant recurrent iritis that was preceded by intraocular hemorrhage. F. H. Haessler.

Bushmich, D. G. **Tissue therapy of trachomatous pannus.** Oftal. Jour. (Odessa), 1946, pt. 2, pp. 22-25.

This form of therapy was applied to trachomatous pannus by Filatov in 1936. Implantation of preserved cadaver mucous membrane from the lip and conjunctiva led to gratifying results. Later Filatov and his school tried implantation of preserved cadaver skin into the conjunctiva and in the skin of the temple, autotransplantation of preserved mucous membrane from the lip, implantation of preserved sclera on the eyeball, and subconjunctival implantation of preserved cartilage. The results were gratifying in all cases. Implantation of placenta and intramuscular injections of cod liver oil were included among the therapeutic procedures. Within recent years Filatov began to experiment with products of vegetation placed in unfavorable environment; he used principally an aqueous extract of leaves of aloes. Kalfa, in experimenting with this extract found considerable absorption of the infiltration of the lids after the subcutaneous injections of extract of aloes, and subcutaneous implantation of preserved skin in 32 patients. These procedures lead to a retrogression of pannus, increased transparency of the cornea, and a diminution of infiltration in the lids. There was no recurrence of the disease.

Ray K. Daily.

Cristini, Giuseppe. **Concerning the histogenesis of benign conjunctival nevus.** Riv. di Oftalm., 1946, v. 1, May, pp. 319-342.

Three cases of benign conjunctival nevus are discussed extensively, illustrated by two photographs and nine microphotographs. Every nevus of the conjunctiva seems to grow from a heterotypic vestige; this is also true for the dermoepithelioma described in this paper. (11 illustrations.)

K. W. Ascher.

Hayes, F. B., and Chamberlain, R. D. **Meningococcal conjunctivitis.** U. S. Naval Med. Bull., 1946, v. 46, May, pp. 758-760.

A unilateral acute purulent conjunctivitis, with intra- and extracellular gram-negative diplococci is described. Shortly after the onset of the conjunctivitis, the patient developed purulent meningitis. Cultures revealed meningococcus type I in eye secretions and spinal fluid. The patient recovered after penicillin therapy. Benjamin Milder.

Kamel, S. **Pterygium. Its nature and a new line of treatment.** Brit. Jour. Ophth., 1946, v. 30, Sept., pp. 549-563.

Histologic study of pterygium revealed the presence of an ordinary hyaline degeneration with much elastic connective tissue. Pterygium begins as a common exposure conjunctivitis. When the inflammation attacks the cornea, a chronic kerato-conjunctivitis results and a pterygium begins to form. Fibrous tissue is laid down in the area and when this contracts, it pulls a fold of loose conjunctiva toward the rigid cornea. The neoplastic and degenerative theories of the etiology of pterygium are untenable.

The McReynolds operation is followed by recurrence in 30 to 50 percent in Egypt. In inactive ptergium the author merely snips off the head of the growth. When a pterygium is active the head is shaved off, and the growth is undermined throughout its length

but it is not dissected from the rest of the conjunctiva. After the undermining it is allowed to fall back into place. Its under surface is carefully cauterized with phenol and the eye is bandaged for a few days. The purpose of the undermining and the cautery is to destroy the fibrous bands which have pulled the fold toward the cornea. In 600 cases there has not been a single recurrence.

Morris Kaplan.

Lavery, F. S. **Sulphonamides and penicillin in the treatment of trachoma.** Brit. Jour. Ophth., 1946, v. 30, Oct., pp. 591-594.

End results of 13 cases of proven trachoma treated with sulphonamides and with penicillin are tabulated. Eight patients were given a sulfonamide for trachoma and five were treated with penicillin. In each group inclusion bodies persisted in four patients.

Morris Kaplan.

Lopez, P. M. **The forms, types, and therapy of simple superficial chronic conjunctivitis.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Nov., pp. 981-993.

For proper treatment of chronic conjunctivitis it is necesssary to make a thorough ocular and general examination. Diseases of the lacrimal apparatus, Meibomitis, errors of refraction, toxic products originating from disturbances of the various organs, and allergy may be etiologic factors. For local therapy he prefers superficial scarification of the cornea followed by the application of alum or copper sulphate pencil. This is followed by the usual colyria and ointments. Diaphonoscopy is urged for the examination of the Meibomian glands, which are a frequent source of chronic conjunctivitis.

Ray K. Daily.

Miller, A. R., and Blower, D. E. **Primary diphtheria of the conjunctiva.** Lancet, 1946, v. 2, Sept. 7, pp. 345-346.

Two cases of primary diphtheria of the conjunctiva are reported by the authors. The first, in a girl, three years of age, manifested itself by nasal and conjunctival discharge. Diphtheria bacilli were found in the eye secretions only. Antitoxin cured the patient promptly. The second case occurred in this child's five-year-old brother.

Francis M. Crage.

Moretti, Ezio. **Eiology and treatment of trachoma.** Rassegna Ital. d'Ottal., 1941, v. 10, March-April, p. 224.

Moretti feels that there is no specific cause of trachoma, but that the disease is a focal reaction to many pathogens. He relates his experience with cutaneous tests and treatment with "esotuberculina" of Finzi. In four patients there were definite positive reactions and improvement with the injections of tuberculin.

E. M. Blake.

Sammis, A. W. **Ophthalmic disease treated with penicillin.** U. S. Naval Med. Bull., 1946, v. 46, June, pp. 912-915.

Two case reports are presented. A severe gonorrheal conjunctivitis cleared in four days after the combined use of intra-muscular and topical penicillin. In the second patient, a persistent chronic conjunctivitis, of two months duration, was cured in six days by the same therapeutic program.

Benjamin Milder.

Simonelli, Mario. **Generalized neurofibromatosis (Recklinghausen's disease) with conjunctival involvement.** Riv. Oto-Neuro-Oft., 1941, v. 18, Sept.-Oct., pp. 435-445.

Conjunctival localization of Reckling-

hausen's disease is rare; the author added his own observation to the thirteen cases described in the literature. (5 photographs, 4 photomicrographs.)
K. W. Ascher.

Sironi, L. **Epithelioma of limbus at the site of a keratosis of the conjunctiva.** Rassegna Ital. d'Ottal., 1941, v. 10, May-June, p. 281.

A small tumor at the limbus recurred twice after removal in a 44-year-old patient. No recurrence or metastasis was observed two years after complete removal. Histologically the tumor was an epithelioma of the Malpighian type, developing at the site of a hyperkeratosis of the limbus (tyloma). The author considers the hyperkeratosis a precancerous lesion. (11 figs.)
E. M. Blake.

Umiker, W., and Crofoot, M. **Stevens-Johnson disease.** U. S. Naval Med. Bull., 1946, v. 46, Sept., pp. 1466-69.

Stevens-Johnson disease, a syndrome of conjunctivitis, stomatitis and dermatitis, is related to erythema multiforme. The conjunctivitis may be severe and there is a painful ulcerative stomatitis. Recovery is spontaneous, and there is no specific treatment. In the case reported, the patient was acutely ill, and in addition to the triad mentioned above, he had balanitis. Penicillin therapy and parenteral amino acids were given. Recovery was complete in five weeks. Benjamin Milder.

Vancea, P. **The electrometric variations of the tissue pH in trachoma.** Revue Bulgare d'Opht., 1943, v. 2, pp. 167-160.

The virus of trachoma causes a considerable acidification of the conjunctival tissue which, nevertheless, returns to normal as soon as the trachomatous lesion clears up. Alice R. Deutsch.

Verzella, Mario. **Types of variants of epibulbar epithelioma.** Riv. di Oftalm., 1946, v. 1, June, pp. 409-425.

Two cases are described extensively, and nine microphotographs presented. One patient had an atypical epithelioma of high malignancy with rapidly spreading metastases which led to the fatal end; the other, with a conjunctival tyloma, had no local recurrency nor metastasis after an observation period of 2½ years. (Bibliography.)
K. W. Ascher.

6

CORNEA AND SCLERA

Bassi, G., and Jona, S. **The ocular manifestations in human alactoflavinosis.** Boll. d'Ocul., 1945, v. 24, Jan.-March, pp. 3-18.

A boy, 12 years of age, had poor vision as long as he could remember. His vision was 1/10 in each eye. The biomicroscopic examination showed a pericorneal injection and most extensive vascularization of the entire cornea. Intense photophobia and lacrimation existed. The condition of the eyes improved after treatment with lactoflavin. After a long discussion the writer concludes that the presence of such general manifestations as glossopathy and goniostomatopathy and the good result obtained from the specific treatment justify the diagnosis, namely alactoflavinosis. (6 illustrations, references.) Melchiore Lombardo.

Bonnet, P. **A diffuse hyperplastic papillomatous tumor of the cornea originating from an old pannus.** Revue Bulgare, d'Opht., 1943, v. 2, pp. 44-54.

The author reports the clinical and

pathological description of a papillomatous growth in a cornea, in an eye with trachomatous pannus. He discusses the possible treatment and prefers temporary blepharoraphy to any other treatment. (4 figures.)

Alice R. Deutsch.

Bowles, L. L., Allen, L., Sydenstricker, V., Hock, C., and Hall, W. **The development and demonstration of corneal vascularization in rats deficient in vitamin A and in riboflavin.** J. Nutrition, 1946, v. 32, July, pp. 19-35.

About 500 Wistar strain rats were used in this study. Some were placed on riboflavin and others on vitamin A deficient diets. The corneas were studied after the ascending aortas had been injected with 5 ml. of india ink.

In riboflavin deficiency conjunctival edema and congestion, usually with photophobia, was the first ocular change, followed after a week by marked congestion of the limbal vessels and occasionally by faint nebula. Soon thereafter capillary "sprouts" began to invade the cornea, in 60 percent from the superior nasal quadrant, in 20 percent from the 12-o'clock meridian above, and in 20 percent from the superior temporal quadrant. A few days later, intense edema and corneal opacification occurred, which obscured the progress of the vascularization. This subsided after one or two weks, when the cornea was heavily vascularized, often with anastomoses in the central portion. The pattern was more of the terminal loop type and less of the dendritic. This vascularization was relatively easily distinguished from the spontaneous vascularization that was found in 4 of the 500 rats.

In vitamin A deficiency, conjunctival edema and congestion with photophobia, occurred first, then xerophthalmia, with an opaque and partially desquamated cornea. Three to seven days later the cornea was diffusely opacified, and capillaries were seen peripherally, usually of the dendritic type, which formed a dense peripheral band. Then edema and leukocytic infiltration often progressed so that the vessels became invisible. (2 plates, 12 figures, references.)

Bennett W. Muir.

Cantuliera, J. A. **Herpetic keratitis. Report of cases.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Sept., pp. 776-790.

A review of the literature on the etiology and therapy of herpetic keratitis is presented. Two cases of dendritic keratitis and two of superficial punctate keratitis treated with satisfactory results with vitamin B_1 are reported.

Ray K. Daily.

Cavara, Vittoriano. **Severe and severest types of herpetic keratitis.** Revue Bulgare d'Opht., 1943, v. 2, pp. 65-73.

After a short review of the classic forms of herpetic keratitis and related types the author describes observations of his own with especial emphasis on two eyes with dense corneal infiltrations of insidious onset which because of their herpetiform fluorescine staining, loss of corneal surface sensivity, and intensive neuralgic pain were considered herpetic in origin. He draws attention to the fact that a severe keratitis of unknown etiology may be herpetic. (References.)

Alice R. Deutsch.

Colombo, Gianluigi. **Cases of epidemic nummular keratoconjunctivitis in Milan.** Boll. d'Ocul., 1946, v. 25, Jan.-June, pp. 297-302.

The writer reports three cases of this affection in members of the same fami-

ly. The patients, two adult women and a man, were treated with sulfathiazole preparations, zinc sulphate, mydriatics and vitamin B_1 with improvement of the conjunctival symptoms but with no marked effect on the corneal symptoms which had began two weeks after the beginning of the affection and two months later were still present. Probably an ultravirus is the causative agent of the disease. In 40 percent the symptoms are limited to the conjunctiva. The disease manifests itself in cold and damp periods, affects adults and can be unilateral. There may be preauricular adenitis, photophobia, catarrhal exudation and all other symptoms of acute conjunctivitis. The corneal manifestations begin with small round numerous grayish infiltrations situated mostly in the pupillary zone. The epithelium remains intact, the corneal sensibility is slightly diminished, and no marked pericorneal injection is visible. The vision is affected greatly. The writer gives a differential diagnosis from other types of conjunctivitis and keratitis. Melchiore Lombardo.

Dejean, C., and Sedan, J. **A clinical and experimental study of corneal lesions caused by indelible pencil and their treatment.** Revue Bulgare d'Opht., 1943, v. 2, pp. 75-83.

Corneal injuries caused by indelible pencils may cause aseptic necrosis. The basic colors are more dangerous than the acid dyes because they penetrate faster and have a selective affinity for the nuclei of the cells.

Two clinical observations and fourteen experimental lesions in guinea pigs are described to demonstrate the necrotizing action of aniline dyes. Deep corneal ulcers and a widespread interstitial keratitis occur in untreated eyes. A thorough and immediate mechanical cleaning of the wound, followed by lavage with 95-percent alcohol, considerably improve an otherwise unfavorable outcome. Alice R. Deutsch.

Ershkovich, I. G. **Keratoplasty in complicated leucomas, following war-injuries.** Oftal. Jour. (Odessa), 1946, pt. 2, pp. 18-21.

Keratoplasty in war injuries is not widely used, because of the severe injuries of the ocular tissues and because of the density of the leucomata. Ocular perforations, which form the greatest number of injuries, were inflicted principally by mine fragments, and along with corneal destruction produced havoc in the deeper structures of the eye. The results of such damage are dense large leucomas, matted with the iris, and with dense cicatricial membranes behind. There is frequently an organized exudate in the anterior chamber. The lens is opaque or partially absorbed. The deeper changes are obscured by the cloudy media, but usually there is organized exudate in the vitreous, traumatic chorioretinitis, proliferative retinitis, optic atrophy, and sometimes retinal detachment. In addition there is frequently flattening of the leucoma or of the entire anterior ocular segment, ectasia of the leucoma, and secondary glaucoma. Such eyes are not considered suitable for keratoplasty. Occasionally, however, keratoplasty in combination with other operations and with persistent tissue therapy may bring about significant visual improvement, which liberates the patient from invalidism, and may even restore a degree of vocational competence. He urges that the surgical indications be extended, and that patients with corneal scars be given the benefit of persistent therapy even in the presence of synechia, cicatricial membranes, vitre-

ous opacities and changes in the fundus. (2 illustrations.) Ray K. Daily.

Filatov, V. P. **Perspectives in keratoplasty.** Vestnik Oft., 1946, v. 25, pt. 1, pp. 34-38.

Filatov credits priority in keratoplasty to Pirm and Elschnig, and claims as his own contribution simplification of technic and utilization of cadaver cornea. On the basis of his experience with over 1,000 eyes he outlines a series of problems under investigation. The most unmanageable complication in keratoplasty is glaucoma, and one of the great needs is an effective antiglaucomatous operation. Improving the transparency of the graft and the biologic conditions of the leucoma is accomplished best by superficial corneal grafts combined with tissue therapy. Removing the opaque anterior corneal layers sometimes gives very satisfactory results, particularly if combined with tissue therapy. The transplantation of the entire cornea for staphyloma is only in its initial stage of investigation. The correlation between the microscopic picture of the leucoma and the results of keratoplasty, and on the optimal period of preservation of cadaver eyes is being studied. Keratoplasty in war-injured eyes is not satisfactory, and studies should be made to determine the optimal period of surgery, the preoperative preparation, and the reaction of traumatized eyes. The possibilities of heteroplasty are indicated by the work of Petrociantz, who succeeded with transplantation of dog cornea on cats. Seltzer's and Shereshevski's work with transplantation of cornea preserved in formalin needs further investigation. The chaotic reports of keratoplasty do not permit an accurate evaluation of the surgical procedures. Filatov urges that corneal leucomas be classified according to their extent and density, and that the surgical results be carefully recorded in relation to the state of the corneal leucoma. The comparison of opacities following interstitial keratitis with dense corneal leucomas obviously leads to confusion. Ray K. Daily.

Gardiner, P. A. **Corneal vascularisation in chronic disease.** Brit. Jour Ophth., 1946, v. 30, Oct., pp. 581-589.

In view of the frequent appearance of corneal vascularization in deficiency diseases 191 patients with duodenal ulcer, rheumatoid arthritis and fibrositis, skin diseases, osteo-arthritis, and some other gastro-intestinal diseases were studied and compared with a control group of healthy persons and persons who had trivial illness. It was shown that the more severe the disease, the more vascular the cornea. However, some vascularisation, often marked, was found in persons with trivial illness. None was found in healthy subjects nor in patients with diseases of functional origin. Possibly the phenomenon could be used to differentiate organic from functional diseases. (5 tables.) Morris Kaplan.

Girones, E. A. **Keratitis punctata.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Sept., pp. 768-775.

A review of the literature, a description of the clinical symptoms, and a discussion of the etiology are presented. The cases seen by the author occurred after an epidemic of acute Koch-Weeks conjunctivitis and were in close relation to an epidemic of upper respiratory infection. Accumulated data on the identity of the Koch-Weeks and the influenza bacillus, suggest that possibly this bacillus is the cause of keratoconjunctivitis producing the inflammation

through the liberation of toxins or an ultravirus. Additional evidence to support this belief is the fact that grippe often begins with conjunctivitis, and that some patients with Koch-Weeks conjunctivitis have severe constitutional symptoms. The onset of the punctate keratitis is sudden, its evolution is slow, and therapy is of little avail. (6 illustrations.) Ray K. Daily.

Golovina, A. C. **Keratoplasty in leucoma in veterans.** Vestnik Oft., 1946, v. 25, pt. 1, pp. 43-46.

Golovina reports six cases of keratoplasty in four veterans with severely injured eyes and extensive intraocular damage. Five eyes recovered some vision. Golovina attributes much importance to preoperative and postoperative tissue therapy. Ray K. Daily.

Gruber. Max. **Cornea verticillata. (Second communication.)** Ophthalmologica, 1946, v. 112, Aug., pp. 88-91.

To a previous report Gruber adds a second family in which cornea verticillata occurred, a condition first described by Fleischer. It was observed in both eyes of a woman, 56 years of age, and of one adult son, and daughter. It is probably an unusual hereditary variation of physiological character. The manner of transmission is not certain. (6 figures, 1 family tree, references.) F. Nelson.

Kinsey, V., and Grant, W. **Determination of the rate of disappearance of mustard gas and mustard intermediates in corneal tissue.** J. Cl. Invest., 1946, v. 25, Sept., pp. 776-779.

The rate of disappearance of H (mustard gas) in corneas in vitro at 23 and 37 degrees centigrade was determined by analysis of cyclohexane-kerosene extracts. For these two temperatures, the half-life of H was found to be approximately 13 and 3 minutes, and the over-all half-life of H and its monochloro hydrolysis product was 18½ and 4 minutes, all respectively.

The effect on corneal tissue was measured by subsequently determining inhibition of swelling of the corneal pieces when placed in water. It was found that the effect was proportional to the number of chlorides of both H and H hydrolysis intermediates available for replacement.

The findings indicate that therapeutic agents designed to react with H within tissues would be without benefit unless used within 3 to 5 minutes after contact with the vesicant.

Theodore M. Shapira.

Lohlein, Walter. **Keratoplasties in keratoconus.** Revue Bulgare d'Opht., 1943, v. 2, pp. 101-111.

Three successful keratoplasties in keratoconus are reported. The author discusses the special indications, difficulties and results of keratoplasties in this disease.

The avascularity of the cornea is an advantage for the operation. The excentric location of the tip of the conus and the thinning of the cornea make the operation more difficult. Early surgery and a large transplant (not smaller than 5 mm.) are recommended so that the whole thinned area is removed. A larger transplant increases the danger of irregular fitting and the formation of a fistula. Alice R. Deutsch.

Matteucci, P. **Corneal lesions in Hodgkin's disease.** Amer. Jour. Ophth., 1947, v. 30, Feb., pp. 136-142. (2 figures, references.)

Mazzoletti, Giorgio. **A case of familial degeneration of the cornea of the nodu-**

lar type. Rassegna Ital. d'Ottal., 1941, v. 10, March-April, p. 171.

A perforating keratoplasty was done on the right eye of a 66-year-old man whose vision was reduced to light perception in each eye. Microscopic examination showed disintegration of Bowman's membrane, hyperplasia of the epithelial cells with changes in the basal layer. The stroma presented an amorphous, granular substance, partially condensed into droplets. Differential staining showed that there were two kinds of substances with opposite reactions, which, however, did not correspond to the description of a basophilic stain below Bowman's membrane and an acidophilic stain in the epithelial cells. (2 figures and bibliography.)

E. M. Blake.

Roshchin, V. P. **The biologic indicator in 124 cases of keratoplasty.** Vestnik Oft., 1946, v. 26, pt. 1, pp. 47-48.

The author presents an analysis of the correlation between the type of leucoma and the transparency of the graft in 124 cases of keratoplasty. In leucoma simplex a transparent graft was obtained in 60 percent of cases, in leucoma adherens in 38 percent, and in leucoma totale in 17.9 percent.

Ray K. Daily.

Samoilov, A. J., and Shivarova, E. D. **The role of sensitivity of a leucoma in the transparency of the graft in keratoplasty.** Vestnik Oft., 1946, v. 25, p. 1, pp. 38-43.

The tabulated data show that corneal sensitivity, as an indication of the trophic condition of the cornea, was an important prognostic indicator of the final visual result in 20 cases of keratoplasty. The transparency of the grafts was in direct relation to the corneal sensitivity of the host. It is advisable to increase the corneal nutrition and sensitivity preoperatively with physiotherapy and tissue therapy.

Ray K. Daily.

Smelser, G. K., and Ozanics, V. **Effect of quick freezing at very low temperatures of donor tissue in corneal transplants.** Proc. Soc. Exper. Biol. and Med., 1946, v. 62, June, pp. 274-277.

To test the late results of frozen material as compared with living transplants, a series of corneal transplantations was done on rabbits. The corneas were frozen in isopentane, and transferred to liquid nitrogen, where they remained for one hour to four days. Not one of the operations was successful; all the transplants became opaque eventually. In a control series of 22 cases all eyes remained clear. The use of frozen tissue is no handicap in the technical details of the operation. (2 figures, references.)

Bennett W. Muir.

Sourdille, G. P. **Technique of corneal grafts in man.** Arch. d'Opht., 1946, v. 6, no. 3, pp. 273-283.

Sourdille reviews the various techniques in keratoplasty and discusses their advantages and disadvantages. He mentions the value of partial nonpenetrating grafts in some cases as a preparation for the classical whole-thickness corneal graft and their value in the treatment of recurrent pterygium, lipiodal degeneration, and dystrophies of the cornea. Penetrating grafts yield a satisfactory percentage of permanently clear grafts. He emphasizes the importance of technique in obtaining clear grafts and describes his own in detail. To obtain his grafts he uses an Elliot trephine with a diameter of 5 mm. and with the bevel on the out-

side. The trephine used for the recipient eye, however, is beveled on its inner face. He has not used mechanical trephines. To protect the iris and lens he has used the knife designed by Nicetic to make a double corneal section. Other instruments include large spatulas, narrow keratomes, and corneal scissors.

In preoperative preparation Sourdille stresses the importance of removing all sources of infection such as lacrimal disease or conjunctivitis. He recommends the coagulation of superficial vessels such as occur in phlyctenular keratitis or, if there is a pannus present, its removal by dissection. Iris adhesions, either to the cornea or to the lens, if extensive, should be removed by iridectomy or by synechotomy. Intraocular tension must be normal preoperatively. For anaesthesia he supplements topical applications of cocaine and adrenalin with retrobulbar injection of procaine. He holds the graft in place by means of a narrow strip of conjunctiva. The source of the graft is important and grafts from eyes with absolute glaucoma and traumatic corneal lesions should be avoided. Postoperative care includes binocular dressings for ten or twelve days, with the first dressing on the fourth or fifth day. The conjunctival strip is allowed to retract on the eighth or ninth day.

The main difficulties in the operation seem to result from poor trephines, from secondary glaucoma, from iris-lens adhesions, from vitreous in the anterior chamber, from secondary expulsion of the graft, and from necrosis of the graft. The author discusses these complications and their treatment. He concludes that in spite of them the operation yields a high percentage of satisfactory results.

Phillips Thygeson.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Adamantiades, B. **Thrombophlebitis as a fourth symptom of recurrent hypopyon iritis.** Ann. d'Ocul., 1946, v. 179, March, pp. 143-147.

A fourth symptom is added to the syndrome of Behcet (hypopyon iritis, ulcers of the mouth and ulcers of the genitals). Venous retinal hemorrhages caused by thrombophlebitis may precede the other elements of the syndrome, especially the hypopyon iritis. Thromboplebitis may also exist in other parts of the body. The etiologic factors may be varied and multiple, with or without an allergic factor, and may be brucellosis, staphyloccic septicemia, tuberculosis, and virus infections of unknown origin. The assumption of an allergic factor helps explain the periodicity, sudden onset, relatively short duration, and the coexistence of dermal erythema, and ulcers of the mouth and genitals. Recurrences have frequently followed exposure to cold. The ocular disease resembles a condition observed in horses. In the first case reported, the ocular condition was considered tuberculous and was treated with methylic antigen, and later with penicillin. Vision was totally lost in both eyes from recurrent attacks during four years. In the second patient thromboplebitis of the lower extremities and retina accompanied the other units of this syndrome. (References.) Chas. A. Bahn.

Arruga, H. **A case of essential atrophy of the iris.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, April, pp. 233-237.

Arruga reports a case of essential atrophy of the iris, in a woman 25 years

of age, with otherwise negative general and local findings. Reference is made to Zentmayer's and DeSchweinitz's cases which were similar to this case, and to Arnold's case, which terminated in glaucoma. (3 illustrations.)

Ray K. Daily.

Bothman, Louis. **Allergic iritis.** Illinois M. J., 1946, v. 89, March, p. 124.

Bothman reviews the literature and reports six cases of iritis with presumptive evidence of allergic etiology. Repeated studies for focal infection were negative. Treatment with atrophine, fever, and calcium failed to prevent recurrences. All patients were highly allergic to several agents. All had involvement of the cornea with superficial infiltrates at one time or another. One has been under controlled treatment with no recurrences for six years.

John B. Hitz.

Bushard, W. J. **Intraocular malignant melanomas of the choroid.** Minnesota Med., 1946, v. 29, Oct., pp. 1005-1007.

The subject is reviewed in brief. The symptomless stage, during which much valuable time so necessary in making an early and exact diagnosis is often lost, receives considerable attention. Most fortunate is the patient in whom the growth occupies the macular area. More often the late toxic signs of glaucoma or iridocyclitis arouse the patient, but the confusing picture may at least temporarily lead to the wrong diagnosis.

Three cases are presented by the author. In one an extensive bullous detachment settled down over a circumscribed elevated mass after a subconjunctival scleral puncture. Unilateral detachment, congestive glaucoma, iridocyclitis, disturbed central vision in one eye without obvious explanation, and phthisical globes call for particular effort in determining presence or absence of introcular neoplasm.

Francis M. Crage.

Carlevarlo, G. **Bilateral ocular manifestations in the heterochromia of Fuchs.** Rassegna Ital. d'Otal., 1941, v. 10, March-April, p. 203.

The author presents four cases of heterochromia iridis and points out that the characteristic changes—precipitates on the posterior corneal surface, partial disappearance of the pigment ring of the iris, and numerous lenticular opacities—are present not only in the heterochromic eye, but to a lesser degree in the other eye. Cataract extraction is not contraindicated and the histologic examination of one lens so studied disclosed nothing unusual. (1 figure.)

E. M. Blake.

Charlin Vicuña, Carlos. **Tuberculin-sensitive iridocyclitis.** Arch. Chilenos de Oft., 1945, v. 2, Nov.-Dec., pp. 28-30.

Spectacular improvement of bilateral iridocyclitis occurred in a woman of 28 years who was treated with extremely minute doses of tuberculin weekly, 0.1 c.c. of a "34 zero" solution (see Torres Estrada, Bol. del Hosp. Oft. de Ntra. Sra. de la Luz, 1944, July-Dec., page 163; abstracted Amer. Jour. Ophth., 1945, v. 28, p. 1063).

W. H. Crisp.

Cortes, Hernan. **Ulcerated gumma of the iris.** Arch. de la Soc. Oft. Hisp.-Amer., 1946, v. 6, Jan., pp. 56-58.

Cortes reports a case of gumma of the iris which healed with pupillary occlusion and cyclitic cataract. For cosmetic reasons, against medical advice, the patient insisted on a cataract extraction. The surgical result was a

vascularized scar with the iris drawn into the incision. Ray K. Daily.

Cristini, Giuseppe. **Angioma of the choroid.** Riv. di Oftalm., 1946, v. 1, June, pp. 374-391.

The author reports a case of angioma of the choroid and discusses its differential diagnosis and pathogenesis. (8 photomicrographs.) K. W. Ascher.

Della Casa, Franz. **A metastatic abscess in the anterior chamber in chronic osteomyelitis.** Ophthalmologica 1946, v. 3, Feb.-March, pp. 152-155.

An abscess in the anterior chamber in a patient with osteomyelitis of the tibia and humerus is described. The hematogenous metastasis was apparently provoked by mild trauma. An embolus was probably located in the intrascleral plexus. (Colored plate.)
Alice R. Deutsch.

Diaz-Caneja, E. **Tubercle of the choroid in tuberculous meningitis.** Arch de la Soc. Oft. Hisp.-Amer., 1945, v. 5, July, pp. 511-518.

Recent studies have demonstrated that choroidal tubercles are demonstrated in only 10 percent of patients with tuberculous meningitis.
J. W. McKinney.

Dominguez, D. D. **Migrating ciliary nodules on the retina.** Arch. de la Soc. Oft. Hisp.-Amer., 1946, March, pp. 265-268.

Von Szily's article on Wandertuberkel, published in the Klin. Monats. f. Augenheil. in 1931 is abstracted, reference is made to Krückmann's article on the subject, and one of these rare cases is reported. A woman, 62 years of age, with a bilateral iridocyclitis, was found to have in the lower periphery of both fundi two white slightly elevated foci, which were regarded as foci of choroiditis. She recovered and returned two years later with an attack in the right eye. Fundus examination at this time revealed no trace of the former choroidal foci in the left eye. In the right eye were two fresh foci of choroiditis in a similar situation. They were nodular in structure, greyish-white, sharply circumscribed and projected definitely above the surface of the retina. One of them was located over a small retinal vessel. The situation of the nodules excluded the diagnosis of retinitis or choroiditis and they were diagnosed as nodules that were detached from the ciliary body and had become fixed on the retina. Dominguez does not agree with Szily that this form of propagation of a lesion of the ciliary body towards the posterior pole is limited to tuberculosis and believes that iridocyclitis of any etiology may extend in this manner. He therefore suggests that the designation of "migratory ciliary nodules," without etiologic commitments is a better term for this phenomenon.
Ray K. Daily.

Duthies, O. M. **A case of congenital cyst of the iris.** Trans. Ophth. Soc. U. Kingdom, 1944, v. 64, pp. 244-247.

In a patient, 17 months of age, a congenital cyst of the iris was removed.

The lesion proved to be a simple cyst of myxomatous tissue lined by pigmented cells. Beulah Cushman.

Enciso, M. M. **A sarcoidal sarcoma discovered incidentally.** Arch. de la Soc. Off. Hisp.-Amer., 1946, v. 6., Jan., pp. 64-68.

An eyeball enucleated with the diagnosis of subacute metastatic uveitis was found to contain a choroidal sarcoma as well as metastatic uveitis. The The diagnosis was confirmed by histo-

logic examination. The author believes that the two affections were purely coincidental. (Photomicrograph.)

Ray K. Daily.

Espíldora Luque, C. **Sympathetic ophthalmia consecutive to subconjunctival rupture of the sclera.** Arch. Chilenos de Oft., 1945, v. 2, Nov.-Dec., pp. 26-28.

A man of 33 years was struck in the right eye with a fist. The subconjunctival rupture of the sclera extended from the ciliary region for about a centimeter backward, in the upper outer region of the globe. There was no hernia of the uvea, nor any suggestion that the crystalline lens had been luxated subconjunctivally. The scleral gap was completely covered by conjunctiva. Total hyperemia prevented internal examination. Vision was reduced to perception of light, with poor projection. The patient disappeared 12 days after the injury, the eye in apparently good condition, although the vitreous was cloudy. Two months later he returned with vision reduced to shadows in the other eye, which had previously been normal. The clinical appearance was that of a sympathetic ophthalmia of the posterior type, but the author doubts whether it would have proved anatomically to be of this character. While undergoing study in the clinic, the patient died of acute yellow atrophy of the liver, and apparently the eyeball was not sectioned.

W. H. Crisp.

Figueiredo, N. P. de. **Iritis secondary to dental abscess (and ? crystalloiditis).** Rev. Brasileira de Oft., 1946, v. 5, Sept., pp. 33-36.

In addition to iritis with whitish spots in the upper and lower angles of the anterior chamber (a sort of hypopyon), there was an irregular pyriform formation almost filling the pupillary area and resting on the crystalline lens. This formation underwent resolution after removal of the tooth. (2 diagrams, references.) W. H. Crisp.

Franceschetti, A. **Rheumatic eye diseases.** Ophthalmologica, 1946, v. 111, Apr.-May, pp. 242-269.

The author reviews the different forms of rheumatic disease and their ocular manifestations. He stresses the importance of ocular diagnosis for the classification of an accompanying joint lesion. Severe acute rheumatic disease rarely involves the eyes, but chronic progressive polyarthritis does. There is apparently no connection between arthritis deformans and iridocyclitis. An exact classification of joint diease, therefore, is an essential prognostic and therapeutic factor.

The clinical appearance of chronic polyarthritis is different in children than in adults. An insidious iridocyclitis with cataract and band-shaped keratitis speaks for a chronic polyarthritis in children, most often of the type Still. A serofibrinous surface iritis and a remarkably increased sedimentation rate favors the diagnosis of rheumatic or tuberculous disease in adults.

The different theories about the origin of rheumatic disease and the difficulties in diagnosis are mentioned. A description of the manifestations in the ocular tissues is given, as well as an outline for its treatment. (10 figures, references.) Alice R. Deutsch.

Goldmann, H. **The drainage of the aqueous in man.** Ophthalmologica, 1946, v. 3, Feb.-March, pp. 146-154.

The appearance of two kinds of veins, one filled with clear fluid, the other with alternating stripes of fluid and

blood, the permanent location of those veins mostly on the nasal and temporal sides of the episclera, the pulsating current of the clear fluid and its increase in amount with pressure on the globe are signs of the constant drainage of the aqueus through Schlemm's canal into the episcleral veins. The pressure which the filtration-angle opposes is very low because the normal variation of the ocular tension is transmitted to the veins and is not lowered by passing through the filtration network. The difference in tension which regulates the outflow of the fluid must be very slight. The resistance of the angular network in the chamber angle must be insignificant and the height of the resistance occurs at the junction of Schlemm's canal and the finest episcleral veins. This clarifies the problem of the effectiveness of a very small iridectomie.

Alice R. Deutsch.

Guglienetti, Luigi. **A melanosarcoma of the choroid with pigmentation of the vitreous.** Revue Bulgare d'Opht., 1943, v. 2, pp. 91-94.

The author describes the clinical and pathologic findings in an aphakic eye in which a melanosarcoma was found. An unusual finding was the diffuse pigmentation of an otherwise normal vitreous. The sector of the conjunctiva corresponding to the tumor was also very much infiltrated with pigment. There were no signs of perforation. The pigment in the vitreous consisted of black punctate masses, partly floating, partly adherent to the retina over the apex of the tumor. They were also seen with the slit-lamp.

Alice R. Deutsch.

Jona, Sergio. **Clinical and biomicroscopic study of three cases of congenital, bilateral aniridia in the same family.** Rassegna Ital. d'Ottal., 1941, v. 10, May-June, p. 303.

The three members affected with congenital bilateral aniridia were the mother and two daughters. One son was unaffected. Jona discusses the different theories as to the development of this anomaly. Concomitant changes are nystagmus, macrocornea, microcornea, marginal corneal opacity different from embryotoxon, congenital and acquired lens opacities, degeneration of the vitreous, and uncertain foveal reflex. An Elliot trephine in one eye failed to reduce the glaucoma and removal of the lens is recommended in similar cases.

In one patient, where the zonular fibers were visible, observations were made on the act of accommodation. (2 figures.) E. M. Blake.

Klauder, J. V., and Dublin, G. J. **Syphilitic uveitis.** Arch. of Ophth., 1946, v. 35, April, pp. 384-399.

This detailed article thoroughly discusses factors in diagnosis and treatment of this disease.

Syphilitic uveitis characteristically occurs in the secondary or late secondary stage of syphilis. The diagnosis is not difficult in patients in whom there is clinical evidence of early syphilis, a positive Wassermann reaction and prompt retrogression of the ocular inflammation after antisyphilitic treatment. The Herxheimer reaction in the uveal tract is described after arsenical and after penicillin therapy. This reaction was observed in 70 percent of the patients. The Herxheimer reaction is discussed from the standpoints of its diagnostic importance and from possible harm that might result from the reaction. Seventy-two cases of syphilitic uveitis are reported and the response to treatment studied. Prompt improvement occurred in patients

given chemotherapy. There was no special advantage noted in the use of fever therapy except as an initial treatment for very severe processes. In patients of this type initial reduced doses of a bismuth compound prior to injection of an arsenical serve the same purpose. Penicillin was used exclusively in seventeen patients with good results. (References.) John C. Long.

Lachman, R., and Pérez Chacón, E. **Cured bilateral endogenous uveitis.** Rev. Oto-Neuro-Oft., 1946, v. 21, May-June, pp. 61-63.

An acute bilateral uveitis with miosis and hypopyon in the right eye developed in an individual with bronchopulmonary disease. He was given penicillin and atropine. The hypopyon disappeared in two to three days, but the miosis persisted. To help overcome this, ephedralin was injected subconjunctivally near the limbus of each eye in the 12-, 3-, 6-, and 9-o'clock positions. This resulted first in irregular mydriasis, and an improved visual acuity. Within a day both pupils were dilated uniformly. On the ninth day of treatment penicillin was stopped. After two weeks vision had improved from light perception to 10/10. (Bibliography.)

Edward Saskin.

Laval, Joseph. **Spontaneous cyst of the iris.** Amer. Jour. Ophth., 1947, v. 30, Jan., pp. 55-57. (2 figures.)

Legroux. **A case of sympathetic neuropapillitis.** Arch. d'Opht., 1946, v. 6, no. 1, pp. 43-45.

The author presents the case of a boy, 15 years of age, who developed sympathetic ophthalmia, limited to the posterior segment, 22 days after a foreign body penetrated and destroyed the sight of the inciting eye. When first seen the vision of the sympathizing eye was 1/10 and a central scotoma was present. Fundus examination revealed an optic neuritis; there were no signs of iris or ciliary body involvement. Enucleation of the inciting eye was performed immediately. A daily dose of six grams of Rubiazol was given for six days. The visual acuity began to rise after the second day and in three weeks had become 6/10. At the same time, however, the edema of the optic nerve and retina increased and at the end of another month the vision had fallen back to 2/10. In addition to a central scotoma, peripheral field constriction developed. Treatment in the following weeks consisted in trepanation of the right sphenoid sinus, a second course of sulfonamides, and finally a course of sodium salicylate. By the end of the ninth month the visual fields had become normal and vision remained stationary at 4.5/10. The fundus had returned to normal except for a slight blurring of the disc margin. The author makes a plea for prophylactic removal of badly damaged eyes.

Phillips Thygeson.

Levine, M., and Gordon, M. **Ocular tumors with exophthalmia in xiphophorine fishes.** Cancer Research, 1946, v. 6, April, p. 197.

The authors report that in four of 500 aquaria (all under the same dietary and environmental influence) they found xiphophorine (swordtail) fishes who showed unilateral or bilateral exophthalmos. Histopathologic study revealed a malignant choroid tumor composed predominantly of epithelioid cells, that resembled the malignant melanomas of the human eye. The etiology of these tumors is unknown,

and their occurrence cannot be explained genetically in Mendelian terms.

Benjamin Milder.

Lijo Pavia, J., and Lachman, R. **Congenital aniridia. Three observations.** Rev. Asoc. med. Argent., 1946, v. 60, April, pp. 179-181.

The authors report three cases of aniridia. The first patient had a total bilateral aniridia associated with zonular opacities and posterior polar cataract in the left eye; the second had an incomplete bilateral aniridia associated with pseudoptosis; and the last an incomplete congenital unilateral aniridia associated with a pseudoptosis. (2 pictures and a brief bibliography.)

Jose Saenz Canales.

McArevey, J. B. **Sympathetic ophthalmitis.** Trans. Ophth. Soc. U. Kingdom, 1944, v. 64, pp. 300-304.

The author emphasizes that operations on secondary cataracts should be avoided. A careful preoperative examination of all eyes with the slitlamp will discover a low grade uveitis. He recommends the removal of an injured eye which suddenly shows fine bedewing of the posterior endothelium or when the clinical appearance of continued irritation persists despite treatment.

During the year 1943 at the Royal Victoria Eye & Ear Hospital, Dublin, 50 eyes were removed after perforating injuries, 20 were examined and in 12 of these sympathetic disease was present. In two patients the second eye had become affected. The shortest intervals of time between injury and enucleation in 10 cases of sympathetic ophthalmia were 9, 12, 17 and 21 days and two of the patients had had injuries for two years before the eyes were enucleated.

Beulah Cushman.

Meesman, A. **A contribution to the pathogenesis of postoperative choroidal detachment.** Revue Bulgare d'Opht., 1943, v. 2, pp. 137-150.

The origin of the postoperative choroidal detachment is discussed.

The author's own experiments consisted of ligations of the vortex veins in rabbits to determine whether a stagnation hyperemia in the choroid with normal or subnormal tension could cause a choroidal detachment. The dilatation of the uveal vessels was considerable but the vitreous did not yield, or shrink, or shift towards the anterior parts of the eye. A choroidal detachment only occurred after paracentesis with a resulting advancement of the iris-lens-diaphragm.

Alice R. Deutsch.

Mosquera, Sanchez. **The separation of iridocapsulary synechia.** Arch. de la Soc. Oft. Hisp.-Amer., 1945, v. 5, Sept., p. 806.

The author emphasizes the value of massage in the separation of fresh synechiae which are resistant to the instillation of a mydriatic.

Ray K. Daily.

Picena, J. P., and Paez Allende, F. **Achromic choroidal melanoma.** Anales Argentinos de Oft., 1946, v. 7, April-May-June, pp. 39-47.

Although the great majority of choroidal sarcomas are melanotic, occasionally a leucosarcoma is observed. An 80-year-old woman had a pale gray tumor at the posterior pole of the right eye. Acute glaucoma supervened and necessitated enucleation. Histologic study of the eye revealed neoplastic sarcomatous tissue with rosettes, and special staining showed the presence of melanoblasts. (Bibliography.)

Edward Saskin.

Reed, H. **Etiology of iridocyclitis in the African.** Brit. Jour. Ophth., 1946, v. 30, June, pp. 324-337.

In Lake Province, Tanganyika Territory of Africa, 42 cases of iridocyclitis were seen. Only 28 patients could be kept in the hospital for complete study. Except for slitlamp examination and some elaborate laboratory studies the investigation was complete. The study was materially hampered by the general preference for the witch doctor's regimen. There were 20 positive Kahn reactions, 8 patients had gonorrhea, 3 relapsing fever, 10 dental sepsis, 9 malaria, 9 schistosomiasis, 8 ankylostomiasis, and 2 taeniasis. The author concludes that the incidence of iridocyclitis in a tropical community is an idex of the extent to which it is disease-ridden.

Morris Kaplan.

Rubino, A., and Corazza, G. **Uveomeningitic syndrome.** Riv. Oto-Neuro-Oft., 1941, v. 18, no. 3, pp. 177-198.

The authors describe the first case of Harada's disease observed in Italy. A benign lymphocytic meningitis was accompanied by a very severe uveitis, which reduced visual acuity of both eyes to finger counting. Two months later, the retinas were reattached, and large areas of depigmentation were found in both fundi surrounding the discs which again had an almost normal appearance. Slight increase of intraocular pressure was due to remnants of synechiae; final vision was 0.3 and 0.2 respectively. A filterable virus was assumed to be responsible for both the meningeal and the uveal lesions.

K. W. Ascher.

von Sallmann, L., and Di Grandi, J. **Hydrogen ion concentration of the aqueous.** Arch. of Ophth., 1946, v. 35, June, pp. 643-654.

A capillary glass electrode was designed to determine the hydrogen ion concentration of the aqueous of rabbits in vitro and in vivo. This technique eliminated many of the errors present in earlier methods. The observers found that the average physiologic pH of the rabbit aqueous was 7.53 with brief local anesthesia and between 7.44 and 7.49 in the initial stage of systemic anesthesia. Exogenous infections of the vitreous with Staphylococcus aureus caused a moderate shift of the hydrogen ion concentration of the aqueous to the acid side. A diet rich in alkali, an increase in the protein of the aqueous, and the iontophoretic introduction of anions had no noticeable effect on the pH of the aqueous. (References.)

John C. Long.

Sorsby, A. and Gormaz, A. **Iritis in rheumatic affections.** Brit. M. J., 1946, April 20, pp. 597-600.

In an attempt to assess the frequency of iritis in the rheumatic affections, 815 patients suffering from the various forms of rheumatism were examined for evidence of active or past iritis and compared with those of a control series. Iritis was observed in 3 of 123 patients with osteoarthritis, in 3 of 53 patients with ankylosing spondylitis in 15 of 332 patients with rheumatoid arthritis and never in 313 patients with other forms of rheumatoid disease. The iritis in rheumatoid arthritis was usually mild, unilateral and recurrent. The inflammatory reactions in the eye and the joint are similar in that they are both ascribed to indirect bacterial activity. The literature is reviewed. It shows little appreciation of the frequency of iritis in rheumatoid arthritis. (References.)

I. E. Gaynon.

NEWS ITEMS

Edited by DONALD J. LYLE, M.D.
904 Carew Tower, Cincinnati 2

News items should reach the editor by the 12th of the month

DEATHS

Dr. Robert Gewanter, Long Island City, New York, died November 10, 1946, aged 44 years.

Dr. Matthew Gerard Golden, Brooklyn, New York, died November 11, 1946, aged 52 years.

Dr. Carl Miller Sneed, Columbia, Missouri, died November 6, 1946, aged 69 years.

MISCELLANEOUS

BOOKS AND WORLD RECOVERY

The desperate and continued need for American publications to serve as tools of physical and intellectual reconstruction abroad has been made vividly apparent by appeals from scholars in many lands. The American Book Center for War Devastated Libraries has been urged to continue meeting this need at least through 1947. The Book Center is therefore making a renewed appeal for American books and periodicals—for technical and scholarly books and periodicals in all fields and particularly for publications of the past ten years. We shall especially welcome complete or incomplete files of the *American Journal of Ophthalmology*.

The generous support which has been given to the Book Center has made it possible to ship more than 700,000 volumes abroad in the past year. It is hoped to double this amount before the Book Center closes. The books and periodicals which your personal or institutional library can spare are urgently needed and will help in the reconstruction which must preface world understanding and peace.

Ship your contributions to the American Book Center, c/o The Library of Congress, Washington 25, D.C. freight prepaid, or write to the Center for further information.

SOCIETIES

MEMBERSHIP THESIS

At the February 25th meeting of the Milwaukee Oto-Ophthalmic Society, Dr. George Dunker presented his thesis for membership. His subject was, "Report on a Series of 18 Cases of Acute Infectious Pseudomembranous Diplobacillary Conjunctivitis."

WILMER RESIDENTS ASSOCIATION

The sixth annual meeting of the Wilmer Institute Residents Association was held at the Johns Hopkins Hospital in Baltimore, April 17th to 19th.

PAN-AMERICAN CONGRESS

Those who expect to attend the Pan-American Congress in Havana January 4 through January 10, 1948, should send their names to Dr. Tomas R. Yanes, P.O. Box 970, Havana, Cuba. The Sociedad Cubana de Oftalmologia has ratified the powers conferred in Montevideo upon Dr. Yanes, who will act as president of the local committee, assisted by members of the Cuban society.

SOUTHWESTERN MEDICAL FOUNDATION

The Southwestern Medical Foundation gave a dinner at Dallas, Texas, on February 28th in honor of Dr. Edward Henry Cary on the anniversary of his 75th birthday.

ATOMIC ENERGY IN MEDICINE

At the February meeting of the Reading Eye, Ear, Nose, and Throat Society held jointly with the Diplomates Association of Berks County Physicians, Dr. Eugene P. Pendergrass spoke on "Atomic Energy in Medicine."

HOLLAND PHYSICIAN SPEAKS

At the January meeting of the Cleveland Ophthalmological Club, Dr. John A. Van Heuven of Utrecht, Holland, was the guest speaker. He gave a most enlightening and interesting paper on "Retinal Detachment." Following his formal paper, Dr. Van Heuven spoke informally on his experiences with the medical division of the underground in Holland.

ANNOUNCEMENTS

HOME STUDY COURSES

The Home Study Courses, sponsored by the American Academy of Ophthalmology and Otolaryngology, in the basic sciences of those two specialties, will be given again, beginning September 1, 1947. Registrations must be completed before August 15th. Detailed information may be obtained from Dr. William L. Benedict, executive secretary, 100 First Avenue Building, Rochester, Minnesota.

OPTICAL AIDS FOR SUBNORMAL VISION

The Committee on Sensory Devices of the National Research Council has available a limited number of reprints of a condensation

of a "Report on a Survey of Optical Aids for Subnormal Vision," by V. S. Ellerbrock, recently published in the *Journal of the Optical Society of America*. There are also available a limited number of copies of the original unabridged report. This report, which was prepared to guide the committee in formulating a program of research, deals with the theory and practical aspects of telescopic spectacles, loupes, reading-glass magnifiers, and projection systems, as well as with recommendations for possible improvements in these devices. Copies of either of these reports will be mailed to professionally interested persons on request to the: Dartmouth Eye Institute, 4 Webster Avenue, Hanover, New Hampshire.

Wilder memorial lecture

Dr. John Q. Griffith, Jr., Laboratory for the Study of Hypertension, Philadelphia, will deliver the third William Hamlin Wilder Memorial Lecture of the Institute of Medicine of Chicago on Friday evening, May 23rd, at the Palmer House. His subject will be, "Rutin: A Therapy for the Hemorrhagic Complications of Hypertension."

Examinations for technicians

The next examination by the American Orthoptic Council will be held in September-October, 1947.

The written examinations will be held at various cities in the country on Friday, September 12, 1947. Only those passing the written examinations will be permitted to take the oral and practical tests, to be given in Chicago, Saturday, October 11, 1947.

Applications on official forms must be received before July 1, 1947. Address the American Orthoptic Council, 23 East 79th Street, New York 21, New York.

Personals

Dr. Franklin M. Foote, New York, has been named medical director of the National Society for the Prevention of Blindness. Dr. Foote formerly was chief of the Division of Local Health Administration, Connecticut State Department of Health, and is now assistant professor of Public Health in Preventive Medicine, Cornell University Medical College.

Leon S. Stone, Ph.D., Bronson professor of Comparative Anatomy, Yale University School of Medicine, New Haven, will receive the Robert W. Doyne Memorial Medal, an annual award of the Oxford Ophthalmological Congress in England. Dr. Stone, who will go to England next summer to address the Congress at Keble College, Oxford, was given the award in recognition of his work on retinal regeneration and vision experiments in transplanted eyes.

Erratum

On page 282 of the March, 1947, issue of the JOURNAL, in the first column, last line of the first paragraph, "45 to 50 mm. wide" should read "45 to 50 μ wide."